Sustainable Finance Regulation, Funds' Portfolio Reallocation and Real Effects *

F. Columba† A. Fabiani‡ R. Gallo§ G. Meucci¶

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Abstract

We show that sustainable investment by mutual funds influences non-financial firms' stock prices and real outcomes. Our identification exploits the EU Sustainable Finance Disclosure Regulation (SFDR) – requiring mutual funds to disclose no, mild, or strong commitment to sustainable investment – and rich microdata. Funds disclosing a mild commitment reduce exposure to high ESG risk ("brown") stocks, relatively to those with no commitment. Differently, strongly committed funds do not adjust, being already perceived as sustainable and facing little incentive to further signal their ESG strategy. The divestment of brown firms occurs independently of their prior sustainability pledges and reduces their stock prices. This reduction is in turn associated with lower environmental spending and higher carbon emissions. Our findings suggest that blanket divestment by ESG funds may unintentionally worsen environmental performance by weakening firms' incentives to invest in sustainability.

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JEL codes: G11, G23, G28, G32, Q5

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†Bank of Italy. Email: francesco.columba@bancaditalia.it.
‡Bank of Italy. Email: andrea.fabiani@bancaditalia.it (*corresponding author*).
§Bank of Italy. Email: raffaele.gallo@bancaditalia.it.
¶Bank of Italy. Email: giorgio.meucci@bancaditalia.it.

1. INTRODUCTION

Institutional investors have increasingly taken into account climate risk and sustainability concerns in their investment decisions (Riedl & Smeets 2017, Dyck et al. 2019, Krueger et al. 2020).[1] However, the design of the most effective investment strategy for promoting sustainability is subject to debate. Indeed, sustainable investment often involves tilting the portfolio towards securities issued by green firms subject to low sustainability risk, which requires divesting from brown firms with high exposure to sustainability risk (Hartzmark & Sussman 2019, Ceccarelli et al. 2023, Gantchev et al. 2023). Such strategy is effective at lowering investors' own portfolio exposure to sustainability risk. However, its ultimate impact on non-financial firms' real outcomes remains unclear. On the one hand, divestment may incentivize brown firms to become more sustainable by raising their cost of capital (Hong et al. 2023). On the other hand, especially to the extent that divestment occurs across the board and penalizes also those brown firms committed to improving their sustainability profile, it may discourage brown firms' effort to become more sustainable (Edmans et al. 2022). Despite the importance of this question, empirical evidence on the prevailing effect is scant. We try to fill the gap.

We exploit a main policy initiative adopted in the European Union (EU) to increase transparency and accountability in ESG investing, the Sustainable Finance Disclosure Regulation (SFDR), which required asset managers to disclose their ESG strategy. This event represented a shock for equity funds and for underlying firms. First, we examine how EU equity funds' investment decisions after the enforcement of the SFDR in March 2021, showing evidence of widespread divestment from brown firms (regardless of their ex-ante commitment to sustainability). Second, we document the implications for mutual funds' net flows and performance. Next, we examine whether mutual funds' portfolio reallocation has implications for the stock returns of the underlying firms and, through this channel, on their investment and non-financial (environmental) performance.

[1] Gibson Brandon et al. (2022), among others, question the transparency and effectiveness of sustainable investment mandates. Moreover, investors' attention to sustainability may vary over time (Baker et al. 2024).

Specifically, the SFDR requires each investment fund domiciled in the EU to disclose in the prospectus how it factors sustainability in its investment strategy according to three labels. Under the SFDR, a fund is labeled as art. 8 (light green) when "it promotes, *among other characteristics*, environmental or social characteristics, or a combination of those characteristics". The second label, art. 9 (dark green), is associated with a relatively stronger commitment to ESG: a dark green fund "has sustainable investment as its *objective*". The remaining funds fall under art. 6 (brown), disclosing that they do not integrate sustainability at all into the investment process. The main goal of the SFDR is to harmonize the definition of sustainable investment in the EU and to make the funds' ESG strategy more transparent to retail investors.[2]

We rely on a rich dataset. Indeed, we focus on EU-domiciled equity funds, holding a conspicuous amount of assets under management (€3.5 trillion at the time of the enforcement of the SFDR) and we retrieve from Morningstar security-level data on fund holdings as well as information on fund-level characteristics and performance indicators. Our final sample comprises funds domiciled in the four major EU economies (France, Germany, Italy and Spain) and in Ireland and Luxembourg, two major financial centers for the EU investment fund industry. Overall, we cover about 65% of the equity funds domiciled in the EU. Next, we proxy exposure to ESG risk through the Morningstar Sustainalytics ESG risk score. For non-financial firms, we employ balance-sheet data from S&P Capital IQ and indicators of environmental sustainability (i.e., environmental expenditure and carbon emissions) from Thomson Reuters Refinitiv Eikon. Finally, we track non-financial firms' sustainability commitment through pledges to the Science Based Target Initiative (SBTi).

Our regressions lever both fund-level and firm-level heterogeneity in triple difference-in-difference (DID) models. We compare stock holdings across: i) funds disclosing to factor sustainability in their investment strategy (through light green and dark green labels), against

[2] Other major jurisdictions have undertaken similar regulatory initiatives. The US SEC has adopted a rule to standardize information in ESG investing (SEC 2024). In the UK the FCA has introduced rules on climate-related disclosures for asset managers (FCA 2021).

(art. 6, brown label) funds which disclose not to factor sustainability; ii) stocks with predetermined high versus low ESG risk exposure; iii) the periods after and before the enforcement of the SFDR. The granularity of the fund-security holding data and the triple DID allow us to use a wide set of fixed effects, including fund-month fixed effects and security-month fixed effects, absorbing any (observed and unobserved) fund-level and security-level time-varying shocks, respectively.

Our findings show that, after the SFDR entry into force, funds disclosing an ESG commitment significantly reallocate their portfolio towards more sustainable stocks. Light green funds only drive the adjustment, whereas the estimated change for dark green funds is not statistically significant.[3]

In particular, light green funds cut their holdings of stocks with relatively higher ESG risk exposure.[4] Quantitatively speaking, light green funds ex-post cut their holdings of stocks with severe ESG risk exposure by 3.6%, relatively to stocks with negligible ESG risk exposure and to brown funds. Interestingly, portfolio reallocation occurs primarily through the exclusion of brown stocks with high ESG risk score, rather than through the purchase of stocks with low ESG risk score. Moreover, light green funds are ex-post disproportionately more sensitive to environmental (E) risk than to social (S) risk and governance (G) risk. The divestment is not attributable to existing pre-trends and is quite persistent, as it remains statistically significant 9 months after the entry into force of the SFDR. These results are robust to saturating our models with different set of fixed effects and employing a matched sample of light green and brown funds.

An important question is whether light green funds discriminate, for a given level of non financial firms' exposure to ESG risk, among those committed to sustainability targets and

[3] This result is reassuring in that, already before the label disclosure, the vast majority of dark green funds had adopted a strong commitment to ESG investment and were assigned the highest ESG rating or the green leaf label by Morningstar.

[4] Morningstar Sustainalytics ranks ESG risk exposure with a score ranging from 0 to higher values generally below 60. A lower risk score than 10 is associated with "negligible" exposure to ESG risk. A higher risk score than 40 is linked to severe exposure to ESG Risk. Intermediate ESG risk scores define low exposure (10 to 20), medium exposure (20 to 30) and high exposure (30 to 40).

those which are not. To this purpose, we exploit quadruple interactions of the usual layer of heterogeneity with information on firms' commitment to the SBTi and on their ex-ante trend in sustainability performance along multiple indicators, most importantly carbon emissions. Our estimates indicate that light green funds do not discriminate along dimensions other than the ex-ante level of the ESG risk score. As a matter of fact, they divest from brown firms independently of their sustainability pledges to the SBTi and/or of eventual improvements in sustainability indicators (e.g., carbon emissions) occurred three years before the entry intro force of the SFDR. Overall, these findings are consistent with the SFDR inducing an indiscriminate (or *blanket*) divestment of brown stocks by equity funds.

We next verify that the effects of the rebalancing go through at the fund level. After the implementation of the SFDR, light green funds experience a 4 percentage point (p.p.) increase in the likelihood of obtaining a "green" sustainability rating (i.e., 4 or 5 globes according to fund-level Morningstar Sustainalytics ratings) and higher inflows (i.e., net flows, rescaled by total net assets, go up by 0.2% on a monthly basis).[5] Interestingly, net inflows are especially higher for funds with weaker ex-ante financial performance (i.e., with lower past excess returns) and, importantly, with worse ex-ante sustainability ratings. These results corroborate the hypothesis that funds try to signal their ESG-investment strategy to attract new financial resources. On the contrary, excess returns do not change significantly for light green funds, as compared to brown funds. Also these findings also hold when employing a matched sample of light green and brown funds.

Finally, we assess whether the documented portfolio reallocation due to the SFDR has ramifications on non-financial firms. First, in order to pin down the effects of the SFDR on non-financial companies, we measure a stock exposure to the reform as the predetermined share (in February 2021) of their market capitalization held by funds disclosing commitment to ESG investment. This allows us to compare ex-post stock returns and other firm-level outcomes (through triple DID models) across firms with heterogeneous exposure and with

[5] This result holds also employing normalized inflows (Hartzmark & Sussman 2019), a measure less sensitive to outliers and volatility than traditional measures of net inflows.

different predetermined ESG risk score. Specifically, we show that divestment by light green funds lowers stock returns for firms with high ESG risk score, relatively to firms with low ESG risk score. In particular, 3 months after the enforcement of the SFDR, an interquartile (IQR) increase in firm-level ESG risk score is associated with a relative 232 basis points fall in stock returns for firms with high ex-ante exposure to light green funds (i.e., with ex-ante ownership share equal to, or larger than, 1%), as compared to firms with low exposure. This effect is long-lived and grows over time (i.e., up to 485 basis points after 1 year). Moreover, in line with security level findings on portfolio rebalancing, the adjustment in stock returns is primarily driven by firms with a high E risk score (rather than by firms with relatively larger values of G Risk and S Risk scores) and is independent of firms' ex-ante commitment and/or trend in ESG-performance. That is, stock returns reflect the fact that funds do not reward preemptive action against sustainability risk, nor prospective pledges.

We conclude by testing whether the "blanket" divestment from brown stocks – and the associated decline in stock prices – is associated with a significant change in brown firms' investment and sustainability. Our findings show that firms with high exposure to the SFDR through significant light green ownership share and with relatively larger exposure to E risk reduce fixed capital investment as well as environmental expenditure. Moreover, consistently with a "disincentive" mechanism, ex-ante committed brown firms cut their environmental expenditure relatively more. Ultimately, such firms do not improve their environmental performance: if anything, blanket divestment from brown firms (and lower stock returns) is associated with a significant relative increase in their carbon intensity (i.e. the ratio between total carbon emissions and revenues), driven by overall higher carbon emissions. The effects are estimated over a relatively short 2-year period and the magnitudes are economically sensible. In particular, a 1 standard deviation (s.d.) increase in ex-ante environmental is associated with a significant relative reduction in firm-level capital by 1.5% for firms with high exposure to light green funds – as compared to firms with low exposure and smaller environmental risk – and with a reduction in environmental expenditure over total revenues by

a factor (7 basis points) equal to one fourth of the ex-ante median. Finally, firms with larger exposure to environmental risk by 1 s.d. and with high exposure to the SFDR experience a relative jump in carbon emission intensity by nearly 6%, primarily driven by larger carbon emissions as opposed to smaller revenues.

Our paper contributes to different strands of the literature on sustainable finance. First, a growing body of paper investigates whether and how institutional investors price sustainability and climate risk in their portfolio choice (Riedl & Smeets 2017, Dyck et al. 2019, Krueger et al. 2020, Gibson et al. 2020, Ceccarelli et al. 2022, Kim & Yoon 2023). Most related to our work, Mésonnier & Nguyen (2020) and Ilhan et al. (2023) exploit a 2015 French reform requiring institutional investors to disclose the carbon emissions associated with their security-portfolio and document an institutional investors' push for heightened environmental disclosure and carbon-transition plans by non-financial firms.[6] We analyze a different reform, the SFDR, requiring all European funds to loosely disclose their approach to ESG-investment, rather than specific granular information about their portfolio. We show that the reform causes blanket divestment of brown firms, contributing to selling pressures and lower stock prices.[7] This result is consistent with evidence of strategic ESG trading by mutual funds and associated buying/selling pressures around disclosure dates (Parise & Rubin forthcoming).

By contrast, Allcott et al. (2026) find limited effects of SFDR on investor allocations and on aggregate mutual fund portfolio sustainability by examining a sample of bond, equity and mixed EU funds, arguing that the labels were largely redundant given investors' pre-existing information. By relying on security-level holdings of equity funds, our paper documents cross-fund, cross-security, and post SFDR variation in a triple-DiD design that allows us to control for fund-time and security-time fixed effects. We show that the adjustment is con-

[6] Azar et al. (2021) show that Big Three engagement in firms' corporate governance is associated with lower carbon emissions. Cohen et al. (2023) find that fund voluntary disclosure through adherence to the Carbon Disclosure Project promotes non-financial firms' disclosure and reduced carbon footprint.

[7] Our findings that the disclosure of an ESG investment strategy is associated with higher inflows are broadly consistent with the evidence on the effects of private sustainability ratings and labels on fund-level performance (Hartzmark & Sussman 2019, Ceccarelli et al. 2023, Gantchev et al. 2023).

centrated among light green equity funds, and this reallocation is associated with significant financial and real effects for more exposed firms.

The documented negative relation between divestment and firms' environmental outcomes complements empirical findings on the nexus between responsible investment by financial investors and non-financial firms' sustainability performance. Among others, Gantchev et al. (2022) show that the threat of exit triggers corrective actions by brown firms. Hartzmark & Shue (2022) document a larger positive correlation between carbon emissions and the cost of capital for brown firms than for green ones. We contribute by showing that blanket divestments can have the unintended effect of raising brown firms' carbon emission intensity by disincentivizing green investment.

As our mechanism exploits incentives associated with adjustments in stock prices, we contribute to the literature on the real effects of secondary financial markets (Bond et al. 2012), and in particular to models of corporate governance through exit (see, among others, Admati & Pfleiderer 2009, Edmans 2009, Edmans & Manso 2011).[8] Edmans et al. (2022) provide the closest theoretical counterpart to our empirical exercise. In their model, brown firms can take corrective actions and are ruled by managers who care about both the fundamental value and the stock price of the firm. In this context, divestment minimizes responsible investors' exposure to brown firms' externalities, reducing their stock price and increasing their cost of capital. However, it does not provide incentives for corrective actions. Hence, optimal responsible investment involves a mix of divestment from brown firms with ineffective plans for corrective actions and tilting of brown firms with effective plans.[9] Our paper provides novel empirical evidence in line with this channel, based on incentives linked to stock price fluctuations in secondary markets.

Finally, our work also speaks to studies on the relation between sustainability risk and stock returns. The available empirical evidence is not conclusive (Pastor et al. 2024), as dif-

[8] See Edmans & Holderness (2017) for a review.

[9] Similarly, Broccardo et al. (2022) show the limits of divestment in incentivizing corrective actions by brown firms, as opposed to an active engagement of investors' in firms' corporate governance ("voice").

ferent papers have shown both instances of underperformance and overperformance of brown stocks vis-a-vis green stocks (Gompers et al. 2003, Hong & Kacperczyk 2009, Edmans 2011, El Ghoul et al. 2011, Chava 2014, Hong et al. 2019, Engle et al. 2020, Bolton & Kacperczyk 2021, 2022, Atilgan et al. 2023, Zhang 2025). Our paper provides novel evidence on how financial regulation, by steering financial flows toward green stocks and away from brown stocks, can increase the return differential between these two classes of securities.

The remainder of this paper is organized as follows. Section 2 explains the institutional context and the main provisions of the SFDR. Section 3 describes data and sample characteristics. Section 4 shows results at the fund-security level to examine the effects of portfolio reallocation, while Section 5 presents evidence at the fund-level. Section 6 focuses on the impact on stock prices and real effects of the new regulation. Section 7 concludes.

2. Institutional Context

The SFDR (Regulation EU 2019/2088) is effective since March 2021 and is one of the main initiatives adopted in the EU to promote sustainable finance. Specifically, this regulation aims to support ESG investment by improving transparency in sustainability-related disclosure in the financial sector. In particular, the main goal of the regulation is to harmonize divergent disclosure standards, thereby allowing the comparison of different financial products.

The SFDR requires, among others, EU fund managers to disclose in the prospectus whether and how they integrate sustainability into their investment strategies by adhering to one of the following three regimes, or labels. Under the SFDR, a fund is labeled as art. 8 (light green) when "it promotes, *among other characteristics*, environmental or social characteristics, or a combination of those characteristics". The second label, art. 9 (dark green), is associated with a relatively stronger commitment to ESG: a dark-green investment fund "has sustainable investment as its *objective*". The remaining funds fall under art. 6 (brown), disclosing that they do not integrate sustainability at all into the investment process. These labels would

allow fund investors to make informed decisions by assessing how sustainability risks are integrated into the investment process of each fund. In principle, such harmonized labels would help investors more sensitive to ESG matters to reward more committed funds, creating in turn an incentive for intermediaries to increase their commitments in order to become more appealing for such type of investors.

The mandate set up by the SFDR in March 2021 is generally quite loose and does not require the disclosure of granular information on the securities the funds invest in. This raised concerns on the ability of the regulation to significantly increase transparency on mutual funds' sustainable investment (Morningstar 2022). Against this backdrop, more detailed rules on the definition of sustainable instruments have been introduced in January 2023, setting up tighter regulatory technical standards (requiring instance ask funds adhering to a green label to invest a minimum percentage of their holdings in sustainable securities, defined as such on the base of relatively strict regulatory definitions).[10] However, our study focuses on the first period of implementation of the SFDR,[11] during which the SFDR prescribed a loose commitment to ESG investment.

3. Data & Sample characteristics

3.1. Data Sources

We combine information from several micro-level datasets. First, we gather monthly open-end mutual funds' characteristics from Morningstar Direct, covering the universe of actively managed funds. We obtain the main characteristics (i.e. total net asset value, net flows, returns, and investment category) as well as Morningstar's 5-star rating - a score based on funds' historical performance - and, crucially, fund-level SFDR-labels.

From Morningstar we also gather ISIN-level information on equity funds' securities holdings. In practice, in each month, we observe the total value of a security's holding by a

[10] In January, the Level 2 Commission Delegated Regulation (CDR 2022/1288) entered into force.
[11] Our sample ends in 2022.

given fund. To obtain the stock price as well as the market capitalization of each security, we merge security holdings data with the Centralized Securities Database (CSDB) through the ISIN code.[12] We retrieve both security-level and fund-level ESG risk scores from Morningstar Sustainalytics.

Finally, we collect non-financial firms' balance-sheet data from S&P Capital IQ and indicators of environmental sustainability (i.e. environmental expenditure and carbon emissions) from Refinitiv Eikon. Finally, we track non-financial firms' sustainability commitment through pledges to the SBTi. We match all information across the different databases through the ISIN code.

3.2. Variable Construction & Summary Statistics

We split the discussion of the main variable construction and summary statistics according to the order of the analyses presented in the paper.

3.2.1. Portfolio Reallocation Analysis

We focus on equity funds with size greater than $10 million and domiciled in the most relevant EU countries for the mutual fund industry, namely France, Germany, Ireland, Italy, Luxembourg, and Spain. In addition, we exclude funds investing exclusively outside of the US and Europe[13] in order to examine a relatively homogeneous sample for which we have enough security-level information. Our baseline sample for the fund-security analysis on portfolio rebalancing consists of 6,442 funds, resulting from data availability on security holdings and fund-level characteristics. According to the SFDR provisions, 202 funds are labeled as dark green, 2,870 as light green, and 3,370 as brown. Overall, these funds account for nearly $2.3 trillion of total net assets (TNA) at the end of February 2021, or about two thirds of the TNA held by EU open-end funds (see Figure 1).

[12] The CSDB is maintained by the European System of Central Banks (ESCB) and reports data on all traded securities held by at least one intermediary reporting information to the ESCB for regulatory and/or statistical purposes.

[13] That is, we exclude funds that are assigned the "Global Category" in Morningstar. For a similar approach, see (Ceccarelli et al. 2023).

FIGURE 1: TOTAL NET ASSETS OF EU FUNDS INCLUDED IN OUR SAMPLE BY SFDR CATEGORY

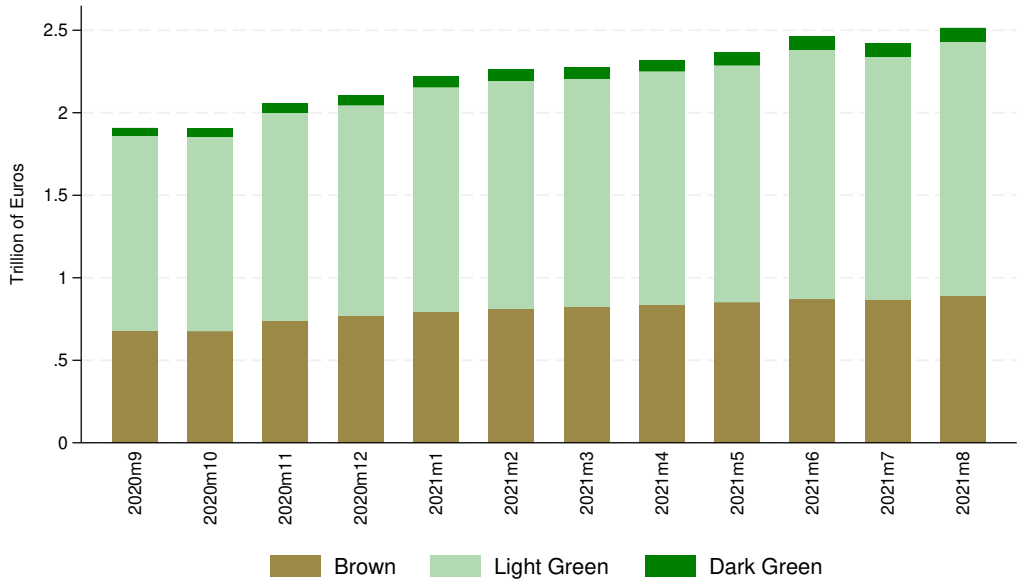


Table A1 in the Appendix displays the summary statistics for the variables employed in the analysis of portfolio reallocation. We obtain the quantity of stocks held by a fund in a given month, denoted by Q, by dividing the value of stock holdings provided by Morningstar by the stock price. By doing so, we ensure that variation in stock holdings reflects fund-level active portfolio management and is independent of changes in stock prices. That being said, our main outcome variable of interest is *Ln(Q)*, the natural logarithm of the units of a stock held by a given fund. The average is 9.58 log-units (corresponding to 14,515 units) and is aligned with the median.

The exposure to ESG risk of a fund's stock holding is measured via the Morningstar Sustainalytics ESG risk score. This measure – denoted by the variable *ESGRisk* – is increasing in firm-level exposure to ESG risk, ranges from 0 to 100 and stems from the sum of firm-level exposure to environmental (E), social (S) and governance (G) risk scores. Sustainalytics uses the ESG risk score to categorize stocks in five categories of ESG risk exposure: negligible (0-10); low (10-20); medium (20-30); high (30-40) and severe (above 40). In Table A1,

the average stock holding of equity fund is characterized by an ex-ante (i.e., as of February 2021) "medium" ESG risk score of about 23. The distribution of *ESGRisk* places firms with "low" or "negligible" ESG risk score in the first quartile (equal to 17) and those with "high" or "severe" exposure above the fourth quartile (close to 28).[14] We also use as a control variable ex-ante stock performance (*StockReturns*), proxied by the ex-ante cumulative 3-month stock returns (i.e., the percentage growth of the related stock between December 2020 and February 2021), equal on average to around 8%.[15]

Regarding fund characteristics, we first introduce two dummies to identify art. 8 and art. 9 funds, respectively *LightGreen* and *DarkGreen*. We also control for ex-ante fund characteristics (as of February 2021), such as fund size (proxied by log total net assets; *LnTNA*), the ratio between fund-level net inflows and lagged (by one month) total net assets (*NetFlows*), winsorized at the 1% and 99% levels, and Morningstar 5-star rating based on fund-level performances (*MSRating*).

We use different variables to gauge firms' ex-ante commitment to environmental sustainability. To start with, we look at firms' pledges to the SBTi.[16] We define a dummy, *SBTi*, with value 1 for those firms pledged to this programme as of February 2021, and with value 0 otherwise. *SBTi* firms represent nearly 3% of those in our sample; they are generally larger and widely present in the portfolios of examined funds as they are about 12% of the observations – at the fund-security-time level – in our sample (Table A1). Moreover, we exploit ex-ante firm-level environmental performance. In particular, during the three years before the SFDR, the average stock holding of equity funds experienced a reduction in the ESG risk score ($\Delta ESGRisk$) of about 1 point, driven by a fall in environmental risk ($\Delta ERisk$) by 1.7 point. Indeed, among others, Co2 emissions in absolute terms ($\Delta Co2Emi$) decreased by

[14] The prime contributor to the ESG risk score is social risk, showing relatively higher mean risk score (9.4) than governance risk (7.6) and environmental risk (5).

[15] We define a firm's stock returns as the percentage growth of the related stock price over a given time horizon.

[16] The Science Based Targets initiative is a collaboration between the CDP, the United Nations Global Compact, World Resources Institute (WRI) and was established in 2015 to help companies to set emission reduction targets in line with climate sciences. The identity of signatories is public and available at the website: https://sciencebasedtargets.org/.

1.4% and by 0.11 expressed as a fraction of revenues ($\Delta Co2Emi/Rev$).

3.2.2. Fund-level Analysis

In our fund-level analysis, we mainly focus on three outcome variables. First, we measure fund-level exposure to ESG risk through adopting the Morningstar Sustainalytics ratings, or globes. In practice, Sustainalytics aggregates the security-level ESG risk scores (described in the previous subsection) to obtain an asset-weighted fund-level ESG risk score associated with portfolio holdings.[17] Next, based on this metrics, and performing a within Global Category comparison, it assigns a rating varying from 1 to 5 globes, with the least and most sustainable funds obtaining 1 and 5 globes, respectively. As of February 2021, both the mean and the median fund in our sample display 3 globes, denoting a medium level of ESG risk exposure. As an outcome variable, we categorize the Sustainalytics globes into a dummy variable, *GreenGlobes*, with value 1 for funds with above-median rating (i.e. equal to 4 or 5). Such funds account on average for 41% of the observations in our sample. Summary statistics, reported in Table A2 in the Appendix, show that *GreenGlobes* funds represent about 40% of the sample.

Second, we focus on net flows. In particular, we use two definitions. The variable *Net-Flows* rescales the monthly net inflows by the lagged value of total net assets. After winsorizing at the 1% and 99% levels, its average equals 0.4% (Table A2), with a high standard deviation (49%). Following Hartzmark & Sussman (2019), we also employ a measure of normalized inflows (*Norm. Flows*), which is robust to the notable extent of volatility displayed by data on net inflows. In practice, for each month m we split funds according to size deciles. Next, within each size-decile d, we compute percentiles for the distribution of *NetFlows* and assign it as a value to *Norm. Flows*. For concreteness, a fund j with median within size-decile value of *NetFlows* is assigned $Norm.Flows_{j,m} = 50$.

Third, we focus on excess returns, computed by first regressing the previous 12 months

[17] Assume a fund invests half of its portfolio in a firm with negligible ESG risk score of 5 and the other half in a firm with severe risk score of 45. Then the fund-level ESG risk score is 25.

of fund returns on four factors, namely the three factors by Fama & French (1993) plus momentum (Carhart 1997). The factors – retrieved from Kenneth French's website – are conditional on the fund's investment geographical area based on Morningstar information (i.e. Global, North-America, Europe, and Emerging Markets). Consistent among others with Pastor & Vorsatz (2020), our variable (*ExcessReturns*) is then computed as the difference between the realized returns and the predicted ones obtained through this methodology. Its average is close to 0 (-0.07%; Table A2). However, it displays a notable extent of variation, with an interquartile range close to 1.7 percentage points.

In our analyses we also control for other fund characteristics. The Morningstar rating (*MSRating*) is a measure (from one to five stars) of a fund's past performance within the same Morningstar category. In our sample the average rating is expectedly around 2.5 stars. We also use the the fund age in years (*FundAge*), calculated from the inception date of the earliest share class; the average age is about 12.6 years, while about a quarter of funds has been established in the last 4 years. Finally, in some specifications, we take into account the Morningstar 5-globe sustainability rating of the fund (*MSSustRating*), as of February 2021, also as a control.

3.2.3. Firm-level Stock Returns & Real Effects Analyses

In the analysis of the implications of the SFDR for stock returns, we focus on stocks included in the portfolios of funds in our sample (described in Section 3.2.1). The cumulative returns of stocks are roughly 4.9% over a 1-month horizon and 9.7% over a 6-month horizon after the SFDR announcement (Table A3).

We estimate a stock's exposure to the SFDR through the share of a firm's market capitalization held by light green funds at the onset of the SFDR in February 2021. We label such variable *Expo*, and its average amounts to 0.88% (Table A3). However, the distribution is heavily right-skewed. Indeed, the median firm substantially displays no light-green holdings, whereas the 0.5% of the third-quartile firm is held by light-green funds. Consistently, only for 17% of the firms light-green holdings are equal to or above 1% of total equity, as denoted

by the dummy variable *HighExpo*.

For the analysis of real effects, we look at balance sheet variables (Table A4). We proxy firm capital via net property plant and equipment, expressed in logs (*Ln(K)*). We also gather data on other standard financial variables. In particular, we exploit log revenues (*Ln(Rev)*) as a dependent variable, while we control for the ex-ante leverage (*Leverage*, defined as the ratio between total liabilities and total assets) and ROE (*ROE*, i.e. net income over equity).

Crucially, we are also interested in firm-level non-financial outcomes. In this respect, we first look at environmental expenditure, a proxy for targeted green investment, expressed both in logs (*Ln(EnvExp)*) and as a fraction of revenues (*EnvExp/Rev*), equal on average to about 1%. Next, we measure environmental performance through log carbon emissions (*Ln(Co2 Emi)*). The average firm emits 12.49 log carbon emissions, or 265,667 tonne of carbon emissions. This variable displays a notable extent of variation: the interquartile range denotes an increase in carbon emissions by a factor of 25 times.[18] This difference might however reflects heterogeneity in the level of economic activity, rather than firm environmental efficiency. For this reason, we also express carbon emissions as a fraction of revenues (*Ln(Co2 Emi/Rev)*), which compresses the interquartile differences to a factor of nearly 4 times.

4. Portfolio reallocation

4.1. Empirical model

First, we focus on the impact of the SFDR regulation on the portfolio reallocation of EU equity funds. The baseline regression sample runs over the period from September 2020 to August 2021, hence comprising two symmetric 6-month windows before and after the enforcement of the SFDR in March 2021. Eq. (1) describes our baseline triple differences-

[18] This number results from the following expression: $\frac{exp(p75)}{exp(p25)} - 1 = \frac{exp(14.18)}{exp(10.91)} - 1$=25.31.

in-differences model:

$$\begin{aligned} Ln(Q_{i,j,t}) =& \beta_1 Post_t * LightGreen_j * ESGRisk_i + \beta_2 Post_t * DarkGreen_j * ESGRisk_i + \\ &+ \mu_{i,j} + \mu_{i,t} + \mu_{j,t} + \Gamma X_{j,i,t} + e_{i,j,t} \end{aligned} \tag{1}$$

The dependent variable, $Ln(Q_{i,j,t})$, is the log-quantity of security i held by fund j in month t, reflecting the active monthly allocation of each fund j in security i.

Our main coefficient of interests, β_1 and β_2, loads the interaction between: $Post_t$ (a dummy with value 1 since the enforcement of the SFDR in March 2021 onward), the two dummies denoting whether fund j discloses an approach to ESG-investment consistent with art.8 (*LightGreen*) or with art.9 (*DarkGreen*), respectively; the ex-ante indicator of security i's exposure to ESG Risk, $ESGRisk_i$. Under the hypothesis that the SFDR induces light and dark green funds to rebalance their portfolio towards relatively more sustainable stocks (as compared to the baseline category of art.6, brown funds), we expect β_1 and β_2 to be strictly negative.

We augment our model with different vectors of fixed effects. To start with, we use fund*security fixed effects, $\mu_{i,j}$, absorbing specific fund-level preferences for a given security and, more broadly, all the time-invariant heterogeneity within a fund*security pair. Second, we use security*time fixed effects, $\mu_{i,t}$, taking care of all observed and unobserved shocks at the security level. Third, we apply fund*time fixed effects, $\mu_{j,t}$, controlling for any fund-level shocks which may impact a fund's investment strategy and hence portfolio allocation.

Moreover, $X_{j,i}$ is a vector of fund-level and security-level controls. In particular, we control for fund size (*LnTNA*), net-flows (*NetFlows*), and Morningstar 5-star rating (*MSRating*). All fund controls, fixed at their level as of February 2021, are interacted with both $Post_t$ and $ESGRisk_i$. We also control for stock performance (*StockReturns*), interacted with $Post_t$ and the SFDR-dummies $LightGreen_j$ and $DarkGreen_j$.

Finally, the error term $e_{i,j,t}$ is double-clustered at the fund and security level, in line with

the sources of heterogeneity identifying our key coefficients of interest (MacKinnon et al. 2023).

4.2. BASELINE RESULTS

Table 1 shows the results from the estimation of Eq. (1). Column (1) refers to the baseline sample from September 2020 to August 2021. The statistically significant and negative coefficient of $LightGreen * Post * ESGRisk$ shows that light green funds cut their ESG risk exposure after the disclore of the label, in relative terms. The effect is economically significant and indicates that light green funds ex-post cut their holdings of stocks with higher ESG risk score by an interquartile range (IQR; i.e. 10 points) by 1.2%, as compared to brown funds and to stocks with lower ESG risk score. Similarly, a 30-point difference in the security ESG risk score, which is equivalent to comparing a stock with negligible ESG risk exposure and one with severe ESG risk exposure, is linked to a relative cut of about 3.6%. Column (2) and (3) extend the sample forward by further adding 3 and 6 months of observations, respectively. The impact remains broadly unchanged.

In contrast, dark green funds do not significantly change their ESG investment strategy after the label disclosure, relatively to brown funds. These findings show that the effects of the SFDR on funds with a strong ESG commitment is very limited, if any, possibly due to the fact such funds were perceived as green yet before the enforcement of the reform (and therefore had no incentive to signal their green status further) and/or that their portfolio was already tilted towards sustainable securities.[19]

As we document a significant impact of the SFDR only among light green funds, in the rest of the paper we focus on this group of intermediaries.

[19] As of February 2021, the share of funds with a Morningstar sustainability rating equal to 4 or 5 globes was greater than two thirds for dark green funds, while it was equal to 47 per cent for light green ones.

TABLE 1: THE SFDR IMPACT ON FUNDS' PORTFOLIO REALLOCATION OVER TIME

Dependent variable:	Ln(Q)		
Sample:	6 months	9 months	12 months
	(1)	(2)	(3)
LightGreen * Post * ESGRisk	-0.0012***	-0.0011***	-0.0012***
	(0.0004)	(0.0004)	(0.0004)
DarkGreen * Post * ESGRisk	0.0009	0.0007	0.0007
	(0.0010)	(0.0011)	(0.0012)
Controls	Yes	Yes	Yes
Fund-Security FE	Yes	Yes	Yes
Fund-Time FE	Yes	Yes	Yes
Security-Time FE	Yes	Yes	Yes
Adj. R-squared	0.9621	0.9571	0.9554
Observations	2318517	3163199	3546699

The table shows the effects of the SFDR on equity funds portfolio allocation across stocks with different exposure to ESG risk. The dependent variable is $Ln(Q)$, i.e. the log-quantity of security i held by fund j in month t. In columns (1)-(3) we examine the average active rebalancing in each fund portfolio, respectively, over 6, 9, and 12 months after the SFDR entry into force. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. *DarkGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 9 mandate. *ESGRisk* is the firm-level ESG risk score. The sample period starts in September 2020 and ends in August 2021. Standard errors are double clustered at the fund-security level. *** p<0.01, ** p<0.05, * p<0.1.

4.3. ROBUSTNESS AND OTHER RESULTS

Since we run a differences-in-differences model, it is crucial to show that the documented effect is not attributable to existing pre-trends. To this aim, we estimate a version of Eq. (1) with time-varying coefficients. We display the resulting coefficients in Figure 2. Reassuringly, the relative cut in holdings of higher ESG risk stocks by light green funds take place in March, immediately after the label disclosure, and remain significant also in the following months, though with a lower magnitude. On the contrary, before the enforcement of the SFDR in March 2021, there is no relative effect of the light green label (as opposed to the brown label) on portfolio allocation across securities with different ESG risk exposure.

Second, we estimate Eq. (1) by using a propensity score matching in order to reduce

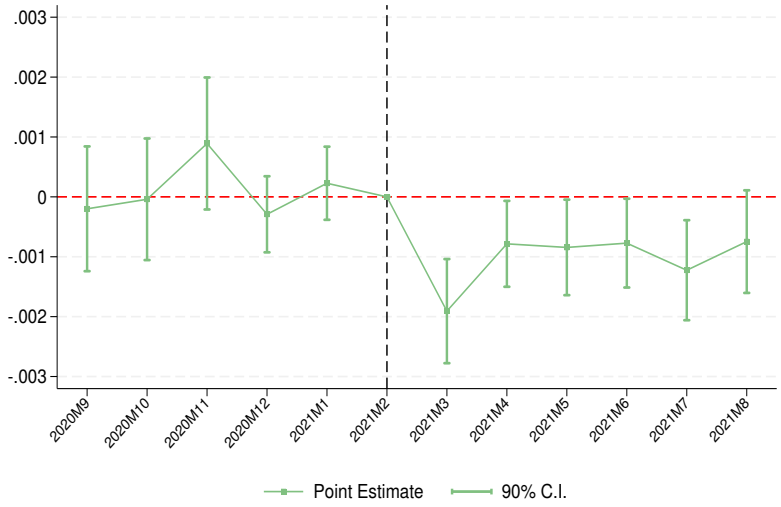
ex ante differences in observable characteristics between light green and brown funds.[20] Table A6 shows that our main results are qualitatively unchanged when we employ the matched sample of funds.

Moreover, there may be worries that the reduction in light green funds' ESG risk exposure reflects the coordinated strategy of a group of funds run by few asset management companies (AMCs), which may be particularly oriented to sustainable investing, rather than fund-level ESG investment labeling dictated by the SFDR. We test this hypothesis by augmenting Eq. (1) with AMC-specific fixed effects, interacted with both the *Post* dummy and *ESGRisk*. Table A7 in the Appendix presents the results of this test. The baseline finding that light green funds ex-post cut their ESG risk exposure is robust to the inclusion of such demanding interacted fixed effects, as the coefficient on the triple interaction *LightGreen*Post*ESGRisk* is still statistically and economically significant.

Afterwards, we focus on the specific mechanics of the portfolio adjustment by light green funds. In particular, we check the extent to which lower portfolio exposure to ESG risk reflects divestment of high ESG risk stocks and/or larger investment in low ESG risk securities. To this end, we categorize the variable *ESGRisk* into three categories: a baseline group of firms with "intermediate" ESG risk score between 10 and 40; a group of "risky" firms with severe exposure to ESG risk (i.e. with score above 40; *HighRisk*); a final group of "safe" firms with negligible exposure to ESG risk score (i.e. with score below 10; *LowRisk*). We replace such two dummies to *ESGRisk* in Eq. (1) and report the coefficients in column (1) of Table 2. Evidently, both divestment from high ESG risk stocks and investment in low ESG risk stocks contribute to the portfolio adjustment of light green funds. However, the magnitude of divestment is greater (4.5 versus 2.4 percentage points) and investment in low risk securities is not statistically significant at conventional levels.

[20] Specifically, we match light green funds (treated) to brown funds (control group) by employing the nearest neighborhood caliper matching approach, accounting for fund-level characteristics in February 2021: *MSRating*, *Age*, *MSSustRating*, size decile, Morningstar's Global Category, and domicile. Table A5 shows that the standardized difference significantly declines for each variable. Overall, Rubin's balance indicators suggest an improvement in comparability between treated and control funds.

FIGURE 2: LIGHT GREEN FUNDS' PORTFOLIO REALLOCATION AROUND THE SFDR LABEL DISCLOSURE



The figure shows the estimated coefficients $\hat{\beta}_{1,t}$ from the following regression model:

$$Ln(Q_{i,j,t}) = \sum_{t \neq 2020m2} \beta_{1,t} * 1(year - month = t) * LightGreen_j * ESGRisk_i + FE + \Psi_t * \chi_{j,i,t} + u_{i,j,t}$$

The dependent variable is $Ln(Q)$, i.e. the log-quantity of security i held by fund j in month t. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. *ESGRisk* is the firm-level ESG risk score. FE denotes a vector of fixed effects, including fund*security fixed effects, fund*time fixed effects and security*time fixed effects. $\chi_{j,i,t}$ is a vector of controls, including the interaction of the dark green label and of predetermined fund size and net flows $u_{i,j,t}$ with $ESGRisk_t$ and the time indicator functions, as well as the interaction of predetermined 3-month stock returns with the light and dark green label dummies and the time indicator functions. $u_{i,j,t}$ is an error term, double-clustered at the fund and security level. The squares report the point estimate of the coefficients $\hat{\beta}_{1,t}$. The bands around the squares depict the 90% confidence intervals.

We also explore heterogeneity across ESG pillars (i.e. environmental, social, and governance) in order to verify whether light green funds target one or more dimensions of the ESG risk of their portfolio. Column (2) of Table 2 displays the results obtained by replacing *ESGRisk* with *ERisk*, *SRisk*, and *GRisk*, indicating the E, S, or G risk score of firm i in February 2021, respectively. Light green funds turn out to reduce their exposure to each of the three pillars of ESG Risk, although the adjustment is strongly statistically significant only for E risk score (at the 1% level), and only marginally statistically significant (at the 10% level) for the G Risk score. On the contrary, the reduction in the S Risk exposure is 1 order

of magnitude smaller and is not statistically significant. Appendix Figure A.1 replicates the exercise with time-varying coefficients. The sharpest reaction around the introduction of the SFDR in March 2021 is associated with a reduction in the exposure to E risk, which also remains more stable and significant going forward. On the contrary, the cut in the G Risk exposure looks relatively more short-lived. Overall, these findings point to the predominance of the E risk exposure in influencing ex-post portfolio investment by light green funds.

Finally, we test whether light green funds divest relatively less from firms ex-ante committed to the SBTi and/or that registered ex-ante improvements in the ESG performance and/or carbon emissions. Results in Table 3 generally reject this hypothesis. The only significant layer of heterogeneity is the ex-ante reduction in the E risk score (column 3). However, this variable correlates substantially with the ex-ante level of the E risk score. As a matter of fact, if we were to dissect the ex-ante ESG risk score into E, S and G risk scores, the interaction would turn insignificant.[21] These findings suggest that the SFDR induced a "blanket" divestment of brown stocks, not rewarding those undertaking a path of improvement of sustainability indicators.

5. Fund-Level Sustainability Scores, Net Flows & Performance

5.1. Empirical Model

In this section we examine the fund-level impact of the SFDR. In particular, we verify whether the label disclosure is associated with an increase in the average fund-level sustainability score for light green funds as well as in funds' net flows and risk-adjusted returns.

To this aim, we employ the model described in Eq. (2).

$$Y_{j,t} = \gamma_1 Post_t * LightGreen_j + \Phi Z_{j,t} + \mu_j + \mu_{c,t} + \mu_{d,t} + \mu_{s,t} + u_{j,t} \tag{2}$$

We examine four different outcome variables (Y). First, we focus on *GreenGlobes* (i.e.,

[21] Results are available upon request.

TABLE 2: THE SFDR IMPACT ON FUNDS' PORTFOLIO ALLOCATION ACROSS HIGH AND LOW ESG RISK SECURITIES AND BY ESG PILLAR

Dependent variable:	Ln(Q)	
	(1)	(2)
LightGreen * Post * LowRisk	0.0225	
	(0.0144)	
LightGreen * Post * HighRisk	-0.0445*	
	(0.0228)	
LightGreen * Post * ERisk		-0.0020***
		(0.0007)
LightGreen * Post * SRisk		-0.0008
		(0.0007)
LightGreen * Post * GRisk		-0.0022*
		(0.0012)
Controls	Yes	Yes
Fund-Security FE	Yes	Yes
Fund-Time FE	Yes	Yes
Security-Time FE	Yes	Yes
Adj. R-squared	0.9621	0.9624
Observations	2317838	1990504

The table shows the effects of the SFDR on equity funds portfolio allocation across stocks with different exposure to ESG risk, exploiting categorical dummies (column 1) and decomposing ESG risk in its components (column 2). The dependent variable is $Ln(Q)$, i.e. the log-quantity of security i held by fund j in month t. *LowRisk* is a dummy with value 1 for firms with *ESGRisk* lower than 10 in February 2021, and *HighRisk* is a dummy with value 1 for firms with *ESGRisk* higher than 40 in February 2021. In column 2, *ERisk* is the firm-level environmental risk score; *SRisk* is the firm-level social risk score, and *GRisk* is the firm-level governance risk score. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. *DarkGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 9 mandate. The sample period starts in September 2020 and ends in August 2021. Standard errors are double clustered at the fund-security level. *** p<0.01, ** p<0.05, * p<0.1.

a dummy variable equal to 1 if fund j has a Morningstar sustainability rating greater than 3 globes). Next, we focus on funds' net flows by employing $NetFlows$, which is equal to monthly net flows of fund j over its lagged TNA, and normalized flows $NormFlows$, in order to avoid that our results are driven by outliers. Finally, we examine *ExcessReturns*, i.e. the fund-level monthly risk-adjusted returns. The sample period runs from September 2020 to August 2021.

TABLE 3: THE SFDR IMPACT ON FUNDS' PORTFOLIO ALLOCATION - EX-ANTE COMMITMENT HETEROGENEITY

Dependent variable:	Ln(Q)				
	(1)	(2)	(3)	(4)	(5)
LightGreen * Post * ESGRisk	-0.0012***	-0.0006	-0.0041**	-0.0015***	-0.0016***
	(0.0004)	(0.0010)	(0.0019)	(0.0005)	(0.0005)
LightGreen * Post * ESGRisk * SBTI	-0.0001				
	(0.0008)				
LightGreen * Post * ESGRisk * ΔESGRisk		-0.0002			
		(0.0009)			
LightGreen * Post * ESGRisk * ΔERisk			-0.0019*		
			(0.0011)		
LightGreen * Post * ESGRisk * ΔCo2Emi				-0.0008	
				(0.0009)	
LightGreen * Post * ESGRisk * ΔCo2Emi/Rev					-0.0007
					(0.0008)
Controls	Yes	Yes	Yes	Yes	Yes
Fund-Security FE	Yes	Yes	Yes	Yes	Yes
Fund-Time FE	Yes	Yes	Yes	Yes	Yes
Security-Time FE	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.9621	0.9626	0.9627	0.9615	0.9615
Observations	2318517	1851525	1666541	1479083	1478983

The table shows the effects of the SFDR on equity funds portfolio allocation across stocks with different exposure to ESG risk and depending on firms' ex-ante commitment or environmental performance. In column (1), *SBTi* is a dummy with value 1 if a firm is committed to the SBTi. In column (2), $\Delta ESGRisk$ is the firm-level variation is the ESG risk score over the period from 2019 to 2021. In column (3), $\Delta ERisk$ is the firm-level variation is the environmental risk score over the period from 2019 to 2021. In column (4), $\Delta Co2Emi$ is the firm-level percentage variation in carbon emissions over the period from 2019 to 2021. Finally, in column (5), $\Delta Co2Emi/Rev$ is the firm-level variation in the ratio between carbon emissions and revenues over the period from 2019 to 2021. In all columns the dependent variable is $Ln(Q)$, which is the log-quantity of security i held by fund j in month t. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. *ESGRisk* is the firm-level ESG risk score. The sample period starts in September 2020 and ends in August 2021. Standard errors are double clustered at the fund-security level. *** p<0.01, ** p<0.05, * p<0.1.

To assess the impact of the SFDR we interact *Post* with *LightGreen*.[22] As a result, the coefficient γ_1 will indicate the effect of the label disclosure in March 2021 on each outcome variable for light green funds, as opposed to brown funds.

Z is a set of fund controls interacted with *Post*, with all variables at their February 2021 levels. In particular, the vector includes $MSRating$, Age, and $NetFlows$, employed only when the dependent variables are *GreenGlobes* and *ExcessReturns*. Moreover, we also control for

[22] We focus on light green funds since the results at the fund-security level suggest that only these intermediaries change their portfolio strategy due to the the SFDR. Nonetheless, we always include *DarkGreen* in the vector of control variables. Unreported coefficients confirm that the fund-level impact of the SFDR is not statistically significant among dark green funds.

fund j's Morningstar sustainability rating ($MSSustRating$). The inclusion of this variable allows us to examine the impact of the SFDR label by taking into account that, also before the entry into force of the regulation, investors could have access to an external assessment of the fund ESG preferences. For each dependent variable, we include its level in February 2021 in order to take into account ex-ante differences across funds.

The model also features different vectors of fixed effects. In particular, fund fixed effects μ_j absorb unobserved time-invariant fund characteristics. In addition, in order to control for time-varying shocks, we add category*time (based on Morningstar's Global Category) and domicile*time fixed effects, denoted by $\mu_{c,t}$ and $\mu_{d,t}$, respectively. We also apply size-decile*time fixed effects $\mu_{s,t}$ by splitting funds into decile based on their TNA (consistent with Hartzmark & Sussman 2019) and interacting each percentile with month dummies. Finally, we cluster standard errors at the fund level.

5.2. Results

Table 4 shows the impact of the label disclosure on each outcome variable. First, the results in column (1) suggest that the likelihood of obtaining a "green" sustainability rating (i.e. 4 or 5 globes) is higher for light green funds in the six months following the label disclosure. In particular, by controlling for their pre-shock level, these funds exhibit a 4 p.p. increase in the likelihood of obtaining 4 or 5 globes with respect to brown ones.

Similarly, we observe that the light green label is associated with significant larger inflows in the six months following the SFDR entry into force (columns 2 and 3 of Table 4). Light green funds attracted on average higher net flows by 0.2% and had normalized flows 1.3 percentiles higher than brown funds. Interestingly, since we are controlling for funds' Morningstar sustainability rating, we observe an additional impact of regulatory-driven information on investors' flows with respect to previously available ESG information. Since fund managers compete in order to maximize assets under management (Chevalier & Ellison 1997), these results provide evidence of a significant incentive for them to disclose a

commitment to ESG investments.

Finally, the label disclosure does not affect light green funds' excess returns (column 4). This suggests that the portfolio reallocation is not linked to a better performance in terms of risk-adjusted returns.

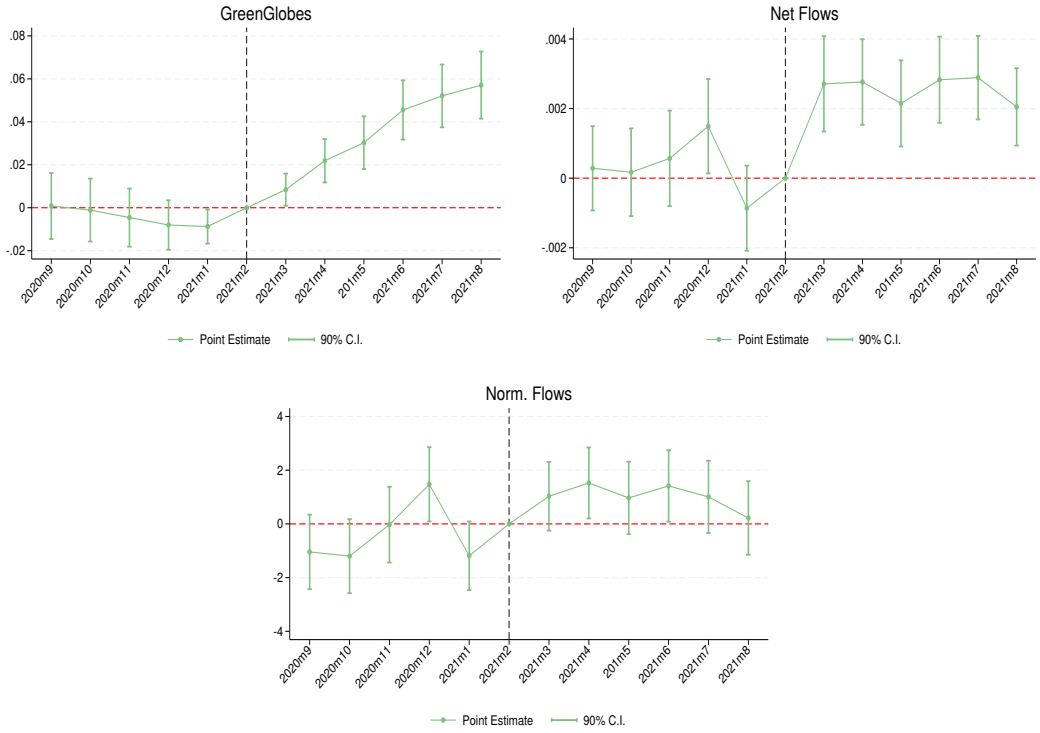
By comparison, for dark green funds, the label disclosure was associated neither with an increase in the likelihood of obtaining a "green" sustainability rating nor higher net subscriptions as related coefficients (i.e. 1.8 p.p. for green globes, -0.2% for net flows, and -1.4 percentile for normalized flows) are not statistically significant. These results confirm that the additional SFDR-induced disclosure did not represent an incentive for funds already perceived as green by investors.

TABLE 4: THE SFDR IMPACT ON FUNDS' SUSTAINABILITY RATING, INFLOWS AND EXCESS RETURNS

Dependent variable:	Green Globes	Net Flows	Norm. Flows	Excess returns
	(1)	(2)	(3)	(4)
Post * LightGreen	0.0394***	0.0022***	1.3132**	-0.0118
	(0.0079)	(0.0005)	(0.5319)	(0.0101)
Controls	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes
Category-Time FE	Yes	Yes	Yes	Yes
Size Decile-Time FE	Yes	Yes	Yes	Yes
Domicile-Time FE	Yes	Yes	Yes	Yes
Adj. R-squared	0.8256	0.3845	0.4082	0.5754
Observations	68894	67846	63500	56652

This table shows the influence of the SFDR on fund-level sustainability rating, inflows and excess returns. In column (1) the dependent variable is *GreenGlobes*, a dummy equal to 1 when the fund has a Morningstar sustainability rating greater than 3 globes, as the dependent variable. In column (2), the dependent variables is $NetFlows$, the ratio between monthly net flows of fund j and its lagged TNA. In column (3), the dependent variable is $NormFlows$, i.e. normalized fund flows (Hartzmark & Sussman 2019). The dependent variable in column (4) is *ExcessReturns*, which is equal to monthly risk-adjusted returns of fund j. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. Controls include $MSRating$, Age, $MSSustRating$, $NetFlows$ (in columns 1 and 4), and the level of the related dependent variable in February 2021. The sample period starts in September 2020 and ends in August 2021. Standard errors are clustered at the fund level. *** p<0.01, ** p<0.05, * p<0.1.

FIGURE 3: THE SFDR IMPACT ON FUND-LEVEL OUTCOMES



The figure shows the estimated coefficients $\hat{\beta}_{1,t}$ from the following regression model:

$$Y_{j,t} = \sum_{t \neq 2020m2} \beta_{1,t} * 1(year - month = t) * LightGreen_j + FE + \Phi Z_{j,t} + u_{j,t}$$

The dependent variables are, respectively: *GreenGlobes*, a dummy equal to 1 when the fund has a Morningstar sustainability rating greater than 3 globes, $NetFlows$, the ratio between monthly net flows of fund j and its lagged TNA, and $NormFlows$, i.e. normalized fund flows (Hartzmark & Sussman 2019). FE denotes a vector of fixed effects, including fund, fund category*time, size decile*time, and domicile*time fixed effects. $Z_{j,t}$ is a vector of controls, including $MSRating$, Age, $MSSustRating$, $NetFlows$ (in the first panel), and the level of the related dependent variable in February 2021. $u_{j,t}$ is an error term, clustered at the fund level. The squares report the point estimate of the coefficients $\hat{\beta}_{1,t}$. The bands around the squares depict the 90% confidence intervals.

5.3. ROBUSTNESS AND OTHER RESULTS

We start by testing for the existence of pre-trends by estimating our model with time-varying coefficients. This test confirms that light green funds experience a relative increase in sustainability ratings and net inflows (compared to brown ones only) immediately after the SFDR entry into force in March 2021 (Figure 3).

We also explore fund-level heterogeneity to shed light on the mechanism behind the fund-

level adjustment. In particular, first, we examine the SFDR effect on funds with a past performance worse than their peers (i.e. those that in February 2021 had 6-month excess returns lower than the median of their Morningstar's Global Category). For this group of funds attracting inflows could be difficult as investors tend to be very sensitive to past performance (Chevalier & Ellison 1997, Goldstein et al. 2017). Second, we focus on the ex-ante sustainability information available for investors. Indeed, funds with lower sustainability ratings (i.e. those with less than 4 globes) may have benefited the most from the adoption of a public label that may help them to inform investors of their tilting towards more sustainable portfolio allocation. Table 5 and Table 6 show the results of each test for the two categories of funds, respectively.

Finally, we estimate Eq. (2) by using a propensity score matching in order to ensure that our findings are not driven by ex ante differences in observable characteristics between light green and brown funds (see Section 4.3 for further details on the methodology). Table A8 shows that our main findings are robust to employing a matched sample of light green and brown funds.

TABLE 5: THE SFDR IMPACT ON FUND-LEVEL OUTCOMES ACROSS UNDERPERFORMING AND OVERPERFORMING FUNDS

Sample:	Underperforming funds				Overperforming funds			
Dependent variable:	GreenGlobes	Net Flows	Norm. Flows	Excess returns	GreenGlobes	Net Flows	Norm. Flows	Excess returns
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post * LightGreen	0.0372***	0.0024***	1.5830**	-0.0067	0.0494***	0.0019**	0.8732	-0.0369
	(0.0096)	(0.0006)	(0.6558)	(0.0109)	(0.0143)	(0.0009)	(0.9416)	(0.0228)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Category-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size Decile-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Domicile-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.8265	0.3599	0.4014	0.6014	0.8209	0.4161	0.4177	0.5423
Observations	45706	45261	42292	43366	23504	22514	21136	13234

This table shows the impact of the SFDR on fund-level outcomes across undeperforming and overperforming funds. Columns (1)-(4) show the results of Eq. (2) estimated by employing the sample of funds with 6-month excess returns below the median in February 2021 and employing respectively *GreenGlobes*, $NetFlows$, $NormFlows$, and $ExcessReturns$ as the dependent variable. Columns (5)-(8) report the results for the sample of funds with 6-month excess returns above the median in February 2021. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. Controls include $MSRating$, *Age*, $MSSustRating$, $NetFlows$ (in columns 1-4-5-8), and the level of the related dependent variable in February 2021. The sample period starts in September 2020 and ends in August 2021. Standard errors are clustered at the fund level. *** p<0.01, ** p<0.05, * p<0.1.

Remarkable differences emerge with respect to net inflows and normalized flows. Indeed, under-performing funds and those with ex-ante "brown" globes exhibit stronger significant inflows after the SFDR entry into force, especially in terms of normalized flows. For both groups our results suggest that funds ex-ante less desirable for investors may benefit the most from the public disclosure of their ESG commitment.[23]

Differently, our evidence suggests that the impact on excess returns is not significant also within subsamples and that both overperforming and underperforming recorded a broadly similar effect on *GreenGlobes*.

TABLE 6: THE SFDR IMPACT ON FUND-LEVEL OUTCOMES ACROSS FUNDS WITH GREEN AND BROWN SUSTAINABILITY GLOBES

Sample:	Brown globe funds			Green globe funds		
Dependent variable:	Net Flows	Norm. Flows	Excess returns	Net Flows	Norm. Flows	Excess returns
	(1)	(2)	(3)	(4)	(5)	(6)
Post * LightGreen	0.0029***	1.8034**	-0.0119	0.0015**	0.9697	-0.0087
	(0.0007)	(0.7247)	(0.0136)	(0.0007)	(0.7713)	(0.0149)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Category-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Size Decile-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Domicile-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.3622	0.3846	0.5834	0.4184	0.4426	0.5863
Observations	38492	36029	32608	29262	27379	23940

This table shows the impact of the SFDR on fund-level outcomes across funds with low versus high Morningstar sustainability rating. Columns (1)-(4) show the results of Eq. (2) estimated by employing the sample of funds with Morningstar sustainability rating lower than 4 globes in February 2021 and employing respectively *NetFlows*, *NormFlows*, and *ExcessReturns* as the dependent variable. Columns (5)-(8) report the results for the sample of funds with higher Morningstar sustainability than 3 globes in February 2021 and employing respectively *NetFlows*, *NormFlows*, and *ExcessReturns* as the dependent variable. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. Controls include *MSRating*, *Age*, *MSSustRating*, *NetFlows* (in columns 3 and 6), and the level of the related dependent variable in February 2021. The sample period starts in September 2020 and ends in August 2021. Standard errors are clustered at the fund level. *** p<0.01, ** p<0.05, * p<0.1.

[23] We employ additional sample splits in unreported results. We find larger effects for smaller funds (i.e. those with a size below the median in February 2021), which are generally more opaque for investors as they have less information on them. In contrast, we do not find significant differences between institutional and retail funds. In principle, institutional investors may be more sensitive to the disclosure of ESG information as they are generally more responsive to fund characteristics and tend to adopt more sophisticated criteria (Evans & Fahlenbrach 2012). However, the impact of the SFDR on funds' ESG portfolio risk scores, net flows, and performance was broadly similar for both groups of funds.

6. The Effects of portfolio reallocation on non-financial firms

6.1. Stock returns

6.1.1. Empirical model

The evidence presented in Section 4 shows that, after the enforcement of the SFDR, light green funds reallocate their portfolio to stocks with relatively lower ESG risk exposure, relatively to brown funds. In this section, we test the hypothesis that the resulting selling pressures on stocks with high ESG risk exposure are associated with a relative decline in stock prices and returns. We employ the following regression model:

$$Ret_i = \beta_1 Expo_i + \beta_2 ESGRisk_i + \beta_3 Expo_i * ESGRisk_i + \gamma X_i + \mu_c + \mu_s + e_i \tag{3}$$

The dependent variable, Ret_i, is the cumulative return on stock i from the end of February 2021 to 3, 6, 9 and 12 months later.[24]

Our key coefficient of interest is β_3, loading the interaction between $Expo_i$ and $ESGRisk_i$. Under our hypothesis that selling pressures on high ESG risk stocks by light green funds are associated with a relative decline in stock returns, β_3 should be negative.

We control for the logarithm of market capitalization (fully interact it with $Expo_i$, X_i) and further augment the model with country and sector fixed effects, denoted by μ_c and μ_s, respectively. Finally, e_i is an error term, clustered at the firm level.

6.1.2. Results

Before showing the results of the formal regression analysis, we investigate graphically the relation between exposure to the SFDR, ESG risk and stock returns. Figure 4 reports two binscatters, representing the relation between ESG risk (x-axis) and 3-month ex-post stock returns (y-axis) across firms with low SFDR exposure (left panel) and with high SFDR exposure (right panel). We define low versus high SFDR exposure according to a 1% ownership share, a convention that we maintain throughout the rest of the paper.

[24] We compute stock returns as the growth rate of stock price over the relevant time-window.

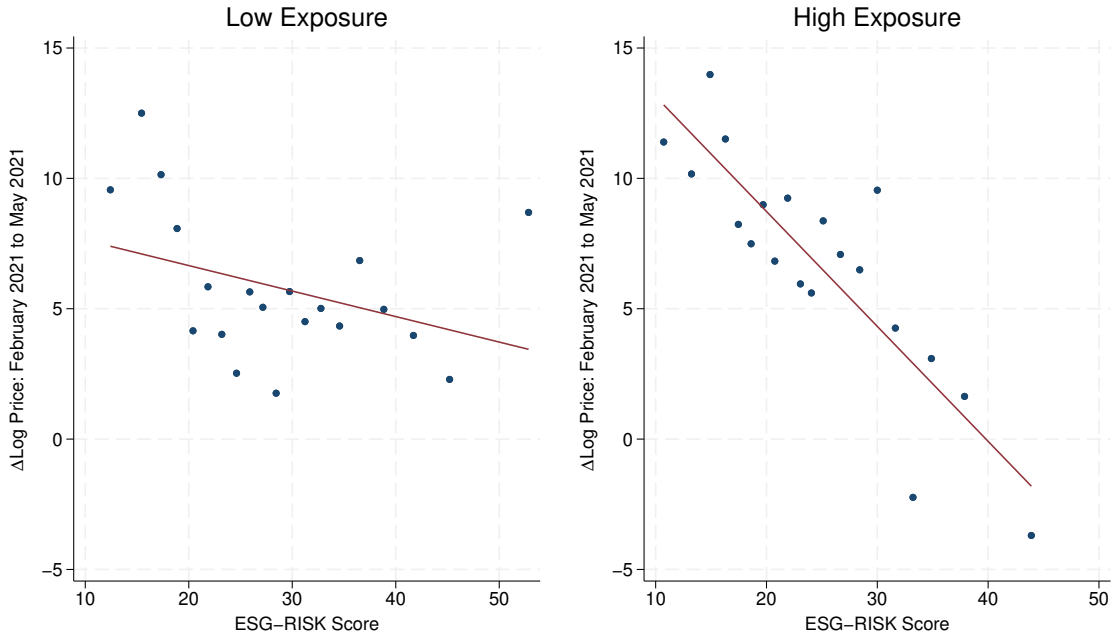
Evidently, the relation between ex-ante ESG risk and ex-post stock returns is remarkably more negative for firms with high exposure to the SFDR. That is, following the enforcement of the SFDR, higher firm-level ESG risk is associated with stronger underperformance for stocks highly exposed to light green funds than for those with low exposure. Interestingly, the same pattern holds if we consider a longer time horizon and plot 6-month stock returns (see Figure A.2 in the Appendix), suggesting that the influence of the SFDR on stock returns is not short-lived. Differently, before the enforcement of the SFDR, a higher exposure to light green funds is not associated with a different relation between ESG risk and stock returns (see Figure A.3 in the Appendix). If anything, the relation is positive and with a similar slope across firms with high and low exposure. These patterns reflect the fact that financial regulation can raise concerns about climate risk exposure and eventually lower demand for highly exposed (brown) securities, thereby depressing their returns (Pástor et al. 2021, Zhang 2025).

The formal regression analysis broadly validates the graphical patterns. Panel A of Table 7 shows the results from the estimation of Eq. (3). At the peak of the effect 9 months after the implementation of the SFDR, a joint 10-point (IQR) increase in *ESGRisk* and 1% jump in *Expo* is associated with a 25 b.p. relative fall in stock returns. At other time horizon, the effect is not statistically signficant at conventional levels. However, in Panel B, we reproduce the same estimation, although substituting the continuous proxy of exposure to light green funds, *Expo*, with a dummy variable for high (above 1%) exposure. Using such proxy of high exposure strengthens our findings: 3 months after the enforcement of the SFDR, a 1 IQR increase in *ESGRisk* is associated with a relative 232 b.p. fall in stock returns for firms with high exposure (as opposed to firms with low exposure). The effect is long-lived and grows over time, at 342 b.p. after 6 months and up to 485 b.p. after 1 year.

6.1.3. Robustness and other results

To make sure that the described results do not reflect pre-trends in ESG risk pricing across firms with different exposure to light green funds, we estimate the following regression

FIGURE 4: SFDR-EXPOSURE, ESG RISK AND EX-POST STOCK RETURNS



This figure describes the relation between firm-level ex-post 3-month cumulative stock returns (y-axis) and ESG risk score (x-axis) across firms with low versus high ex-ante exposure to light green funds, $Expo_i$. The chosen threshold is 1% ex-ante exposure. Each point denotes the median ex-post return and ex-ante ESG risk score within different quintiles of the distribution of ESG risk score.

model with time-varying coefficients:

$$Ln(P)_{i,t} = \sum_{t \neq 2021m2} b_{1,t} * HighExpo_i * ESGRisk_i + \Gamma_t X_{i,t} + \mu_i + \mu_{c,t} + \mu_{s,t} + \phi_{HighExpo,t} + \phi_{ESGRisk,t} + \varepsilon_{i,t} \quad (4)$$

The dependent variable is the monthly firm i stock price, expressed in natural logarithm. We saturate the model with firm fixed effects, μ_i, as well country*time and sector*time fixed effects, denoted by $\mu_{c,t}$ and $\mu_{s,t}$, respectively. Moreover, we also interact both $ESGRisk_i$ and $HighExpo_i$ with time-specific dummies, absorbing any potential time-trend associated with ESG risk and SFDR exposure, respectively; the resulting set of coefficients are respectively labeled $\phi_{ESGRisk,t}$ and $\phi_{HighExpo,t}$. $X_{i,t}$ comprises the full interaction of firm log market cap-

TABLE 7: SFDR-EXPOSURE, ESG RISK AND STOCK RETURNS

Panel A: Continuous Measure of Exposure

Dependent variable:	Cumulative Returns since Feb. 2021 (%)				
Sample:	1 month	3 months	6 months	9 months	12 months
	(1)	(2)	(3)	(4)	(5)
ESGRisk*Expo	0.00277	-0.00599	-0.0148	-0.0248*	-0.0191
	(0.00411)	(0.00763)	(0.0111)	(0.0132)	(0.0130)
Country FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.087	0.103	0.067	0.068	0.116
Observations	6010	5952	5886	5835	5785

Panel B: High (Above 1%) Measure of Exposure

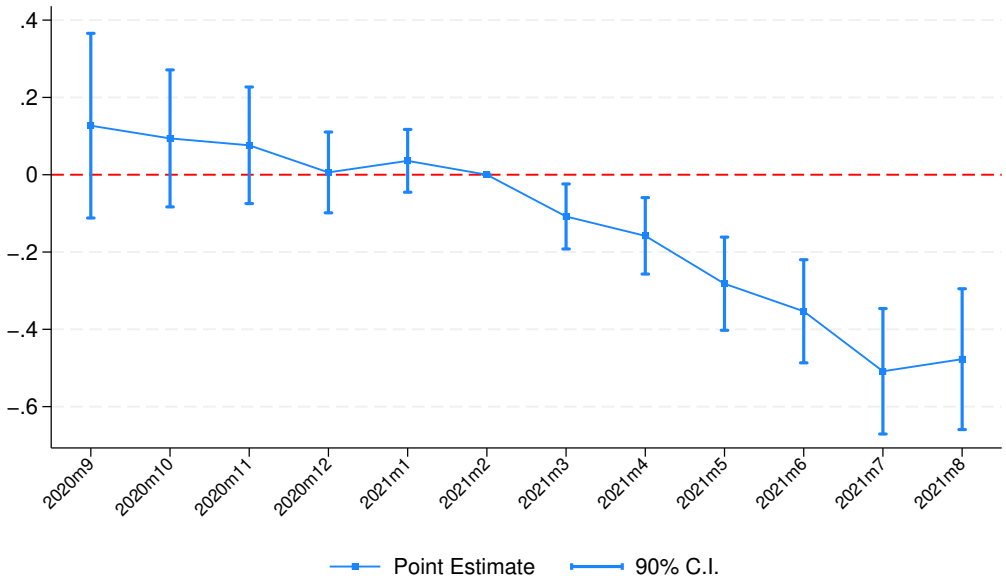
Dependent variable:	Cumulative Returns since Feb. 2021 (%)				
Sample:	1 month	3 months	6 months	9 months	12 months
	(1)	(2)	(3)	(4)	(5)
ESGRisk*HighExpo	-0.0529	-0.232***	-0.342***	-0.485***	-0.486***
	(0.0463)	(0.0723)	(0.103)	(0.138)	(0.151)
Country FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.089	0.107	0.069	0.070	0.119
Observations	6010	5952	5886	5835	5785

This table shows the relation between ESG risk, exposure to SFDR (through light green funds ownership) and stock returns. Formally, the displayed coefficients refer to coefficient β_3 in Eq. (3). The dependent variable is given by the cumulative stock returns from February 2021 to: March 2021 (column 1); May 2021 (column 2); August 2021 (column 3); November 2021 (column 4); February 2022 (column 5). *ESGRisk* is the firm-level ESG risk score. In Panel A, *Expo* is the share of a firm ex-ante held by light green funds. In Panel B, *HighExpo* is a dummy with value 1 if a a firm's *Expo* is equal or above 1%, and with value 0 otherwise. In both panels we control for the full interaction of *Expo* or *HighExpo* with the log market capitalization. Standard errors clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

italization with high SFDR exposure and time dummies. Figure 5 displays the estimated coefficients $\hat{b}_{1,t}$. Before the implementation of the SFDR in March 2021, the pricing of ESG risk exposure is not statistically different across firms with high versus low exposure to light green funds. Differently, after March 2021, higher ESG risk implies relatively lower price for firms with higher exposure to light green funds. The plotted coefficients reflect a growing discount over time, converging to about 50 b.p. per unit of ESG risk score by the end of 2021, in line with cross-sectional estimates in Table 7.

Next, we investigate whether any specific pillar of ESG risk exposure (environmental, so-

FIGURE 5: SFDR-EXPOSURE, ESG RISK AND STOCK PRICES: TIME-VARYING EFFECT (IN %)



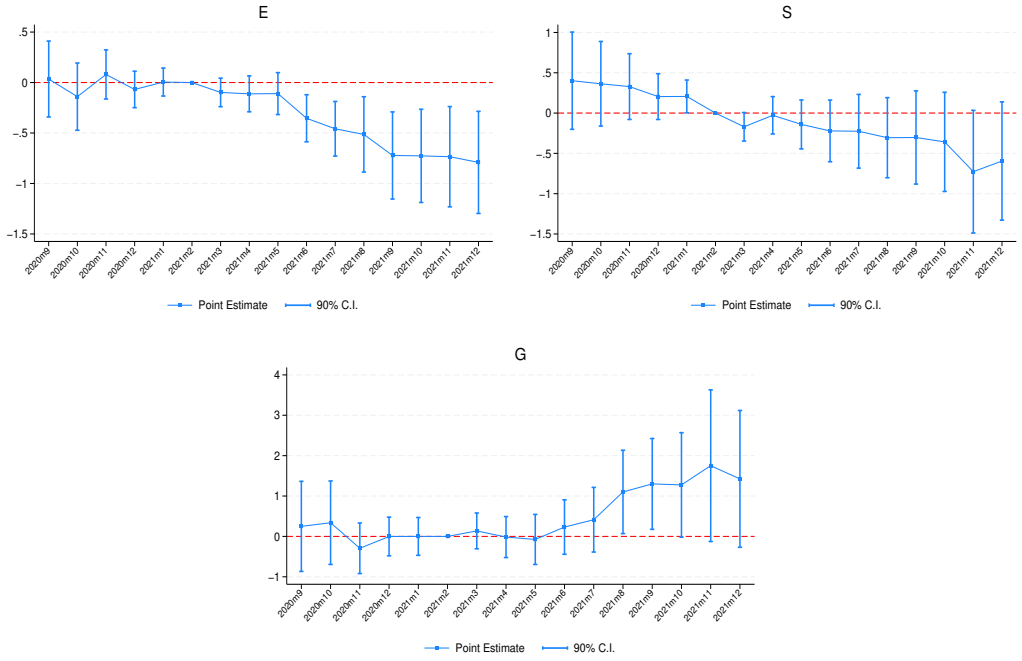
This figure displays the estimated coefficients $\hat{b}_{1,t}$ from the following regression model:

$$Ln(P)_{i,t} = \sum_{t \neq 2021m2} b_{1,t} * HighExpo_i * ESGRisk_i + \\ + \Gamma_t X_{i,t} + \mu_i + \mu_{c,t} + \mu_{s,t} + \phi_{HighExpo,t} + \phi_{ESGRisk,t} + \varepsilon_{i,t}$$

The dependent variable is the monthly log stock price for firm i. *HighExpo* is a dummy with value 1 if a the ex-ante ownership share of firm i by light green funds is higher than 1%, and with value 0 otherwise. *ESGRisk* is the firm-level ESG risk score. $X_{i,t}$ comprises the full interaction of firm log market capitalization with high SFDR exposure and with time dummies, as well as the interactions of *HighExpo* and *ESGRisk* with the time dummies, respectively. μ_i is a vector of firm fixed effects. $\mu_{s,t}$ is a vector of sector*time fixed effects. $\phi_{HighExpo,t}$ is the interaction of *HighExpo* with time fixed effects. $\phi_{ESGRisk,t}$ is the interaction of *ESGRisk* with time fixed effects. $\varepsilon_{i,t}$ is an error term, clustered at the firm level.

cial or governance) exerts an especially negative ex-post effect on the stock price of firms with relatively higher ex-ante exposure to light green funds. According to the results on portfolio reallocation in Section 4, light green funds adjust their holdings primarily by selling environmental-risky stocks. Hence, if the ex-post dynamics of stock returns reflect the portfolio-reallocation channel, it should be the case that the stock price fall in Figure 5 reflects a relatively stronger effect of *ERisk* (as compared to *SRisk* and *GRisk*). To verify this

FIGURE 6: SFDR-EXPOSURE, ESG RISK AND STOCK RETURNS: INVESTORS' FOCUS ALONG THE E,S,G SPECTRUM (IN %)



This figure displays the estimated coefficients from the regression model:

$$Ln(P)_{i,t} = \sum_{t \neq 2020m2} (e_t HighExpo_i * ERisk_i + s_t HighExpo_i * SRisk_i + g_t HighExpo_i * GRisk_i) + \\ + \Psi_t \Xi_{i,t} + \mu_i + \mu_{s,t} + \mu_{c,t} + \phi_{HighExpo,t} + \sum_{j=E,S,G} \phi_{jRisk,t} + \varepsilon_{i,t}$$

The dependent variable, $Ln(P)_{i,t}$, is the natural logarithm of firm i stock price in month t. $HighExpo$ is a dummy with value 1 if a the ex-ante ownership share of firm i by light green funds is higher than 1%, and with value 0 otherwise. $ERisk_i$ if firm i ex-ante environmental risk score. $SRisk_i$ if firm i ex-ante social risk score. $GRisk_i$ if firm i ex-ante governance risk score. $\Xi_{i,t}$ is a vector of controls, including the full interaction of firm i market capitalization (expressed in natural logarithm) with $HighExpo_i$ and the time dummies, as well as the lower level interactions of $ERisk_i$, $SRisk_i$, $GRisk_i$ and $HighExpo_i$ with time dummies, respectively. $\varepsilon_{i,t}$ is an error term, clustered at the firm level. The upper-left panel displays the estimated coefficients $\hat{e}_t$. The upper-right panel displays the estimated coefficients $\hat{s}_t$. The lower panel displays the estimated coefficients $\hat{g}_t$.

hypothesis, we estimate Eq. (4) by splitting *ESGRisk* in *ERisk*, *SRisk* and *GRisk*. We plot the resulting time-varying coefficients (loading the interaction of sustainability risk scores with light green funds exposure) in Figure 6. In line with our hypothesis, the fall in stock price is driven by environmental (E) risk, as adjustments along the social (S) and governance (G) dimensions are generally not statistically different from 0.

A final question is whether stock returns reflect blanket divestment documented in Section 4. Table 8 confirms this conjecture. Indeed, ex-ante SBTi commitment does not moderate the negative impact of high exposure to light-green funds for brown firms.

TABLE 8: SFDR-EXPOSURE, ESG RISK AND STOCK RETURNS - RESULTS CONDITION ON EX-ANTE FIRM-LEVEL COMMITMENT

Panel A: Continuous Measure of Exposure

Dependent variable:	Cumulative Returns since Feb. 2021 (%)				
Sample:	1 month	3 months	6 months	9 months	12 months
	(1)	(2)	(3)	(4)	(5)
ESGRisk*Expo	0.00279	-0.00378	-0.0136	-0.0252*	-0.0203
	(0.00418)	(0.00768)	(0.0119)	(0.0143)	(0.0134)
ESGRisk*Expo*SBTI	0.0101	-0.00703	0.000110	0.0295	0.0586**
	(0.00796)	(0.0164)	(0.0214)	(0.0306)	(0.0267)
Country FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.087	0.101	0.066	0.068	0.116
Observations	6010	5952	5886	5835	5835

Panel B: High (Above 1%) Measure of Exposure

Dependent variable:	Cumulative Returns since Feb. 2021 (%)				
Sample:	1 month	3 months	6 months	9 months	12 months
	(1)	(2)	(3)	(4)	(5)
ESGRisk*HighExpo	-0.0505	-0.214***	-0.420***	-0.582***	-0.589***
	(0.0469)	(0.0755)	(0.107)	(0.144)	(0.156)
ESGRisk*HighExpo*SBTI	-0.112	-0.196	0.0830	0.608	0.108
	(0.130)	(0.301)	(0.362)	(0.444)	(0.466)
Country FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.089	0.075	0.067	0.070	0.120
Observations	6019	5959	5892	5840	5790

This table shows the relation between ESG risk, exposure to SFDR (through light green funds ownership) and stock returns. Formally, the displayed coefficients refer to coefficient β_3 in Eq. (3). The dependent variable is given by the cumulative stock returns from February 2021 to: March 2021 (column 1); May 2021 (column 2); August 2021 (column 3); November 2021 (column 4); February 2022 (column 5). *ESGRisk* is the firm-level ESG risk score. In Panel A, *Expo* is the share of a firm ex-ante held by light green funds. In Panel B, *HighExpo* is a dummy with value 1 if a firm's *Expo* is equal or above 1%, and with value 0 otherwise. In both panels we control for the full interaction of *Expo* or *HighExpo* with the log market capitalization. *SBTi* is a dummy variable with value 1 for firms ex-ante committed to SBTi. Standard errors clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

6.2. REAL EFFECTS

We conclude by examining potential real effects of light green funds' portfolio reallocation. Lower stock returns for brown firms exposed to light green funds imply higher future expected returns, i.e. higher cost of capital. On the one hand, firms may react by taking corrective actions to become relatively more sustainable, in an attempt to lower the cost of capital (Hong et al. 2023). On the other hand, especially to the extent that higher cost of capital also applies to firms ex-ante committed to some sustainability target (as shown to be the case in our empirical context in subsection 6.1), higher cost of capital may discourage further green investment aimed at complying with such targets (Edmans et al. 2022). Ultimately, whether the former or the latter effect prevails is an open empirical question, which we tackle in this section. In particular, we employ the following model:

$$Y_{i,t} = \beta_1 HighExpo_i * ERisk_i * Post_t + \gamma Z_{i,t} + \mu_f + \mu_{s,t} + e_{i,t} \tag{5}$$

We study the effect of the policy on different outcome variables $Y_{i,t}$, including both (balance-sheet) measures of firm physical capital and revenues, as well as different non-financial indicators of environmental sustainability. As above, $HighExpo_i$ is a dummy for firm-level high exposure to light green funds[25] and $ERisk_i$ is the firm-level environmental risk score. $Z_{i,t}$ is a vector of firm-level controls, including the full interaction of $SRisk_i$, $GRisk_i$, ex-ante log market capitalization, ROE and leverage with the post dummy and $Expo_i$. We saturate the model with firm, sector*time and country*time fixed effects, denoted by μ_f, $\mu_{s,t}$ and $\mu_{c,t}$, respectively. We estimate the baseline model in the two years around the SFDR entry into force (2020-21) and report results in Table 9.

In column 1, a 1 s.d. increase in ex-ante environmental is associated with a significant

[25] We focus on the dichotomous high-exposure dummy because we have shown that large exposure is associated with significant decline in stock returns. However, results are broadly aligned if we use the continuous proxy of exposure to light green funds, as further discussed below.

TABLE 9: SFDR-EXPOSURE, ESG RISK AND REAL EFFECTS

Dependent variable:	Ln(K)	Ln(Rev)	Ln(EnvExp)	EnvExp/Rev	Ln(Co2 Emi)	Ln(Co2 Emi/Rev)
	(1)	(2)	(3)	(4)	(5)	(6)
Post*High-Expo*E-Risk	-0.00241*	-0.000521	-0.0157	-0.000386***	0.00620[a]	0.0103**
	(0.00146)	(0.00301)	(0.0121)	(0.000144)	(0.00398)	(0.00436)
Post*E-Risk	0.00144	0.00515***	0.00607	0.0000131	-0.00101	-0.00781**
	(0.00109)	(0.00134)	(0.00825)	(0.0000867)	(0.00353)	(0.00363)
Post*High-Expo	0.0342	-0.0911	0.0478	-0.00114	0.000395	-0.0354
	(0.0436)	(0.113)	(0.322)	(0.00308)	(0.120)	(0.129)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector*Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country*Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.992	0.997	0.988	0.968	0.985	0.976
Observations	16927	4796	1084	1092	3826	3820

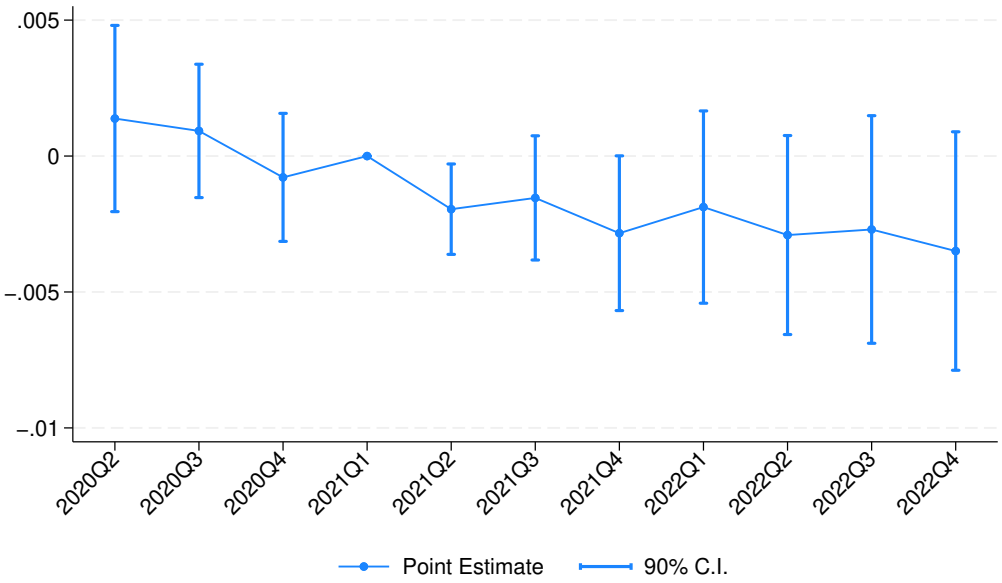
This table shows the coefficients β_1 obtained by estimating Eq. (5) for each outcome variable. In column (1), the dependent variable is $Ln(K)$, which is firm log capital as proxied by net property plant and equipment. We employ firm-level quarterly data on capital (from 2020m4 to 2021m12); for all other variables, we use yearly data (for 2020 and 2021). In column (2), the dependent variable is $Ln(Rev)$, which is firm yearly log revenues. In column (3), the dependent variable is $Ln(EnvExp)$, which is firm yearly log environmental expenditure. In column (4), the dependent variable is $EnvExp/Rev$, which is firm yearly environmental expenditure over revenues. In column (5), the dependent variable is $Ln(Co2Emi)$, which is log total (equivalent) carbon emissions. In column (6), the dependent variable is $Co2Emi/Rev$, which is total (equivalent) carbon emissions over revenues. In column (1), *Post* is a dummy with value 1 from March 2021 onward and with value 0 otherwise. In columns (2)-(6), *Post* is a dummy with value 1 in 2021 and with value 0 in 2020. *ERisk* is the firm-level environmental risk score. $High-Expo$ is a dummy with value 1 if a firm's exposure to light green funds, $Expo$, is above 1%. We control for the full interaction of $Expo$ and the post dummy with the log market capitalization, leverage, ROE and firm-level S Risk and G Risk score. Standard errors clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1, [a] p<0.15.

relative reduction in firm-level capital by 1.5% for firms with high exposure to light green funds,[26] as compared to firms with low exposure and lower environmental risk. As we use quarterly data for investment, we can check- within the short-one year window around the entry into force of the SFDR - the existence of eventual pre-trends. In this respect, the plotted time-varying coefficients in Figure 7 are reassuring, as they clearly show that the negative effect shows up only after the enforcement of the SFDR.

In column 2, we verify whether revenues change similarly for browner and highly exposed firms. The coefficient is negative and points to a marginal fall in revenues, which is however not statistically significant at conventional levels. In column 3, we use a measure of investment more directly related to firm's environmental risk, namely environmental expenditure. Again, browner and highly exposed firms undergo a relative negative though statistically

[26] We multiply our coefficient of interest by the standard deviation of E risk in Panel A of Table A4, i.e. 0.00241×6.257.

FIGURE 7: SFDR-EXPOSURE, ESG RISK AND FIRM CAPITAL: TIME-VARYING COEFFICIENTS



The figure displays the estimated coefficients $\hat{\beta}_{1,t}$ from the estimation of the following regression equation:

$$Ln(K)_{i,t} = \sum_{t \neq 2021q1} \beta_{1,t} HighExpo_i * ERisk_i + \Omega_t X_{i,t} + \mu_i + \mu_{c,t} + \mu_{s,t} + u_{i,t}$$

The dependent variable, $Ln(K)_{i,t}$, is the log of net property plant and equipment of firm i in quarter t. $ERisk$ is the firm-level environmental risk score. $High-Expo$ is a dummy with value 1 if a firm's exposure to light green funds, $Expo$, is above 1%. $X_{i,t}$ is a vector of controls, including the whole interaction of log market SRisk, Grisk, capitalization, leverage and ROE with the time dummies and $HighExpo_i$, as well as all the lower level interactions of as well as the lower level interactions of $ERisk_i$ with time dummies, respectively. μ_i is a vector of firm fixed effects. $\mu_{c,t}$ denotes country*time fixed effects. $\mu_{s,t}$ is a vector of sector*time fixed effects. $u_{i,t}$ is an error term, clustered at the firm level.

insignificant variation. In column 4, we rescale environmental expenditure by revenues. It turns out that browner and highly exposed firms ex-post reduce the annual share of sales devoted to environmental expenditure. While the cut is small in absolute value (24 b.p. in correspondence of a 1 s.d. jump in both *ERisk*), it corresponds to about 70% (25%) of the median (mean) environmental expenditure to revenues ratio.

Overall, these findings suggest that mutual funds' divestment from brown firms' stocks ultimately reduce their investment and their environmental expenditure (Edmans 2011). In

TABLE 10: SFDR-EXPOSURE, ESG RISK AND REAL EFFECTS - RESULTS CONDITIONAL ON FIRM-LEVEL EX-ANTE COMMITTMENT

Dependent variable:	Ln(K)	Ln(Rev)	Ln(EnvExp)	EnvExp/Rev	Ln(Co2 Emi)	Ln(Co2 Emi/Rev)
	(1)	(2)	(3)	(4)	(5)	(6)
Post*High-Expo*E-Risk*SBTI	0.00785	0.0117*	0.0348	-0.00121***	0.00510	0.00681
	(0.00653)	(0.00694)	(0.0276)	(0.000314)	(0.0119)	(0.0253)
Post*High-Expo*E-Risk	-0.00293	-0.00146	-0.0193[a]	-0.000314**	0.00586a	0.0109**
	(0.00204)	(0.00296)	(0.0126)	(0.000124)	(0.00405)	(0.00451)
Post*High-Expo*SBTI	-0.00779	0.0497	-0.790	-0.00671	0.181	-0.0612
	(0.133)	(0.147)	(0.890)	(0.00797)	(0.237)	(0.230)
Post*E-Risk*SBTI	0.00117	0.00402	0.00341	-0.0000880	0.0103[a]	-0.0139
	(0.00482)	(0.00379)	(0.0238)	(0.000135)	(0.00671)	(0.0220)
Post*High-Expo	0.0681	-0.0497	0.0970	0.000166	-0.0147	0.0692
	(0.0576)	(0.0748)	(0.335)	(0.00267)	(0.123)	(0.125)
Post*E-Risk	0.00162	0.00492***	0.00553	0.0000172	-0.00162	-0.0122***
	(0.00141)	(0.00133)	(0.00860)	(0.0000860)	(0.00353)	(0.00319)
Post*SBTI	0.00188	-0.0874	-0.238	-0.00554	0.0258	0.216
	(0.0763)	(0.0777)	(0.681)	(0.00505)	(0.153)	(0.168)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Country*Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector*Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.990	0.997	0.988	0.969	0.985	0.964
Observations	26530	5530	1084	1092	3826	6175

This table shows coefficients obtained by estimating Eq. (5) for each outcome variable. In column (1), the dependent variable is $Ln(K)$, which is firm log capital as proxied by net property plant and equipment. We employ firm-level quarterly data on capital (from 2020m4 to 2021m12); for all other variables, we use yearly data (for 2020 and 2021). In column (2), the dependent variable is $Ln(Rev)$, which is firm yearly log revenues. In column (3), the dependent variable is $Ln(EnvExp)$, which is firm yearly log environmental expenditure. In column (4), the dependent variable is $EnvExp/Rev$, which is firm yearly environmental expenditure over revenues. In column (5), the dependent variable is $Ln(Co2Emi)$, which is log total (equivalent) carbon emissions. In column (6), the dependent variable is $Co2Emi/Rev$, which is total (equivalent) carbon emissions over revenues. In column (1), *Post* is a dummy with value 1 from March 2021 onward and with value 0 otherwise. In columns (2)-(7), *Post* is a dummy with value 1 in 2021 and with value 0 in 2020. *ERisk* is the firm-level environmental risk score. *Expo* is the share of a firm ex-ante owned by light-green funds. *SBTi* is a dummy with value 1 if the firm is ex-ante committed to SBTi. We control for the full interaction of *Expo* and the post dummy with the log market capitalization and firm-level S Risk and G Risk score. Standard errors clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1, [a] p<0.15.

turn, this may be associated to a relative worsening of brown firms' environmental performance, a conjecture confirmed by the results in columns 5 and 6. In column 5, browner (by 1 s.d.) and highly exposed firms experience a relative 3.9% per cent increase in total carbon emissions. The coefficient is marginally not statistically significant, however. In column 6, consistent with the insignificant adjustment in revenues (column 2), those firms also increase their carbon intensity – i.e. the amount of carbon emissions needed to generate 1 dollar of

revenues – by nearly 6% per cent.[27]

Finally, in line with the evidence of blanket divestment in Section 4, real effects are significant among brown firms irrespectively of whether they had ex-ante committed to SBTi and/or ex-ante took actions to improve their sustainability scores. If anything, in Table 10, we find that ex-ante committed firms cut environmental expenditure relatively more, in line with a mechanism in which blanket divestment disincentives further effort (Bond et al. 2012, Edmans et al. 2022).

7. Conclusion

We investigate whether and how sustainable investment by mutual funds influences non-financial firms' stock prices and real outcomes, including indicators of environmental sustainability. Our identification exploits the enforcement of the EU Sustainable Finance Disclosure Regulation (SFDR) – requiring mutual funds to disclose their approach ESG investment – and rich micro-level datasets, including security-level equity funds' portfolio holdings and non-financial firms' sustainability indicators.

Our results show that the funds committing to ESG investment through the SFDR disclosure rebalance their portfolio towards stocks with relatively lower ESG risk exposure, thereby attracting larger inflows. In particular, such funds divest brown (i.e. environmental-risky) stocks, generating selling pressures which ultimately lead to a fall in the price of brown stocks. Put differently, the SFDR is associated with reduced demand and lower stock price for brown firms. Importantly, divestment do not discriminate brown firms ex-ante committed to aligning with sustainability targets, nor those displaying ex-ante stronger improvements in ESG-performance. Hence, we test whether they ultimately disincentivize further investment and action against sustainability risk. The empirical analysis validate this hypothesis. Brown firms relatively more exposed to the SFDR - through a larger share of their market capital-

[27] We replicate the same estimates in a sample including the observations for 2022, for understanding the persistence of the real effects. The results, reported in Table A9 in the Appendix, show substantially aligned estimates, though estimated more imprecisely. However, the increase in carbon emission intensity remains significant at conventional levels.

ization held by equity funds committed to sustainable investment via the SFDR - display lower investment, a cut in environmental expenditure and a worsening of different indicators of environmental performance, including a significant increase in carbon emission intensity.

Our findings raise a warning against sustainable investment taking the form of blanket exclusion of brown firms from investors' portfolio, as well as against financial disclosure regulation which may induce such portfolio reallocation like the SFDR. By simply tilting investors' demand toward green stocks, such divestment may discourage corrective action against sustainability risk by highly-exposed firms, in particular efforts aimed at abating carbon emissions.

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APPENDIX

TABLES

TABLE A1: SUMMARY STATISTICS FOR REGRESSIONS ON PORTFOLIO REALLOCATION

	mean	p25	median	p75	sd	N
Ln(Q)	9.583	8.098	9.580	11.061	2.277	2,318,517
LightGreen	0.540	0.000	1.000	1.000	0.498	2,318,517
DarkGreen	0.038	0.000	0.000	0.000	0.191	2,318,517
ESGRisk	22.881	17.170	22.120	27.720	7.916	2,318,517
ERisk	5.021	1.260	3.300	7.650	4.889	1,990,618
SRisk	9.407	6.490	9.060	12.100	4.115	1,990,618
GRisk	7.605	5.720	7.120	8.990	2.575	1,990,618
Post	0.540	0.000	1.000	1.000	0.498	2,318,517
LnTNA	19.380	18.305	19.437	20.570	1.600	2,318,517
NetFlows	0.038	-0.009	0.001	0.017	2.042	2,318,517
MSRating	2.656	2.000	3.000	4.000	1.553	2,318,517
StockReturns	0.080	-0.033	0.044	0.150	0.662	2,318,517
SBTI	0.116	0.000	0.000	0.000	0.321	2,318,517
Δ ESGRisk	-0.884	-1.127	-0.901	-0.669	0.332	1,851,677
Δ ERisk	-1.688	-1.918	-1.783	-1.534	0.295	1,666,781
Δ Co2Emi	-0.014	-0.160	-0.043	0.109	0.387	1,479,307
Δ Co2Emi/Rev	-0.115	-0.278	-0.117	0.025	0.383	1,479,207

This table shows summary statistics for the regressions analyzing portfolio reallocation. **Definition of the variables**. The sample period runs from September 2020 to August 2021. Ln(Q) is the natural logarithm of the quantity of a given security held by a fund. LightGreen is a dummy with value 1 for light green funds, i.e. disclosing ESG-investment according to art. 8 of the SFDR, and with value 0 otherwise. DarkGreen is a dummy with value 1 for dark green funds, i.e. disclosing ESG-investment according to art.9 of the SFDR, and with value 0 otherwise. ESGRisk is the firm-level Sustainalytics ESG risk score as of February 2021. ERisk is the firm-level Sustainalytics environmental-risk score as of February 2021. SRisk is the firm-level Sustainalytics social-risk score as of February 2021. GRisk is the firm-level Sustainalytics governance-risk score as of February 2021. Post is a dummy variable with value 1 from March 2021 onwards, and with value 0 before. LnTNA is the natural logarithm of fund-level total net assets as of February 2021. NetFlows is the ratio between fund-level net inflows and lagged (by one month) total net assets as of February 2021. MSRating is the Morningstar fund-level performance rating as of February 2021. Stock Returns are the 3-month cumulative firm-level stock returns as of February 2021. SBTi is a dummy variable with value 1 for firms committed to SBTi as of February 2021, and with value 0 otherwise. Δ ESGRisk is the change in firm-level ESG risk score between 2018 and 2020. Δ ERisk is the change in firm-level environmental-risk score between 2018 and 2020. Δ Co2Emi is the change in firm-level total (scope 1 + scope 2) carbon emissions score between 2018 and 2020. Δ Co2Emi/Rev is the change in firm-level total (scope 1 + scope 2) carbon emissions to revenues ratio between 2018 and 2020.

TABLE A2: SUMMARY STATISTICS FOR FUND-LEVEL REGRESSIONS

	mean	p25	median	p75	sd	N
GreenGlobes	0.414	0.000	0.000	1.000	0.493	68,894
NetFlows	0.004	-0.008	-0.000	0.012	0.028	67,849
Norm. Flows	53.380	28.000	55.000	80.000	29.318	65,381
ExcessReturns	-0.070	-0.673	-0.072	0.494	0.962	58,192
LightGreen	0.450	0.000	0.000	1.000	0.498	68,894
DarkGreen	0.032	0.000	0.000	0.000	0.176	68,894
Post	0.499	0.000	0.000	1.000	0.500	68,894
MSRating	2.356	1.000	3.000	4.000	1.619	68,894
FundAge	12.569	4.000	11.000	19.000	9.456	68,894
MSSustRating	3.299	3.000	3.000	4.000	1.088	68,894

This table shows summary statistics for the regressions on fund-level variables. **Definition of the variables**. The sample period runs from September 2020 to August 2021. GreenGlobes is a dummy variable equal to 1 if the fund has a Morningstar sustainability rating greater than 3 globes (i.e. 4 and 5 globes). NetFlows is the ratio between fund-level net inflows and lagged (by one month) total net assets. Norm. Flows is equal to the normalized flows within each size decile. ExcessReturns is equal to monthly risk-adjusted returns of fund *j*. LightGreen is a dummy with value 1 for light green funds, i.e. disclosing ESG-investment according to art. 8 of the SFDR, and with value 0 otherwise. DarkGreen is a dummy with value 1 for dark green funds, i.e. disclosing ESG-investment according to art.9 of the SFDR, and with value 0 otherwise. Post is a dummy variable with value 1 from March 2021 onwards, and with value 0 before. MSRating is the Morningstar fund-level performance rating as of February 2021. FundAge is the fund age in years calculated from the inception date of the earliest share class. MSSustRating is equal to the 5-globe Morningstar sustainability rating of the fund as of February 2021.

TABLE A3: SUMMARY STATISTICS FOR STOCK RETURNS REGRESSIONS

Panel A: Cross-Sectional Regressions

VARIABLES	mean	sd	p25	median	p75	N
$Returns^{1m}$	4.895	10.56	-0.759	4.951	10.83	6,010
$Returns^{3m}$	5.825	20.14	-5.401	4.795	15.86	5,952
$Returns^{6m}$	9.732	27.10	-6.250	7.174	23.07	5,886
$Returns^{9m}$	7.141	34.86	-13.87	3.112	24.45	5,835
$Returns^{12m}$	4.422	37.72	-16.90	2.329	22.69	5,785
Expo	0.876	3.276	8.91e-05	0.0127	0.503	6,010
HighExpo	0.173	0.378	0	0	0	6,010
ESGRisk	28.19	10.05	20.56	27.09	34.52	6,010
Ln(MCap)	23.43	2.576	21.37	23.14	25.16	6,010
SBTI	0.0120	0.109	0	0	0	735,126

Panel B: Panel Regressions

VARIABLES	mean	sd	p25	p50	p75	N
Ln(Price)	2.708	1.651	1.780	2.868	3.781	71,363
HighExpo	0.174	0.379	0	0	0	71,363
ESGRisk	28.13	10.05	20.49	27.02	34.44	71,363
ERisk	7.661	6.284	2.470	6.340	11.68	33,670
SRisk	10.39	4.624	7.190	9.930	13.16	33,670
Grisk	7.674	2.414	6.010	7.350	8.980	33,670

This table shows summary statistics for the cross-sectional stock returns regressions. **Definition of the variables**. All the variables are defined at the firm-level. Panel A reports summary statistics referring to cross-section stock returns regressions. Panel B reports summary statistics referring to panel stock returns regressions (sample from September 2020 to August 2021). $Returns^{xm}$ is the cumulative stock return from February 2021 to x months ahead, $x = \{1,3,6,9,12\}$, defined as the % growth in stock prices. Expo is the % of equity held by light green funds as of February 2021. HighExpo is a dummy value with value 1 for firms with Expo greater or equal to 1%, and with value 0 otherwise. ESGrisk is the Sustainalytics ESG risk score as of February 2021. Ln(MCap) is the natural logarithm of a firm stock market capitalization as of February 2021. SBTi is a dummy variable with value 1 for firms committed to SBTi as of February 2021, and with value 0 otherwise. Ln(Price) is the (time-varying) stock price, expressed in natural logarithm. ERisk is the Sustainalytics environmental-risk score as of February 2021. SRisk is the Sustainalytics social-risk score as of February 2021. GRisk is the Sustainalytics governance-risk score as of February 2021.

TABLE A4: SUMMARY STATISTICS FOR REAL EFFECTS REGRESSIONS

Panel A: Quarterly Regressions

VARIABLES	mean	sd	p25	p50	p75	N
Ln(K)	14.24	1.786	13.19	14.32	15.42	16,927
HighExpo	0.246	0.430	0	0	0	16,927
ERisk	7.568	6.257	2.400	6.160	11.58	16,927
GRisk	7.607	2.349	5.950	7.330	8.940	16,927
SRisk	0.0522	1.030	-0.662	-0.0346	0.676	16,927
Ln(MCap)	24.337	2.403	22.593	23.881	25.895	16,927
Leverage	0.300	0.186	0.159	0.299	0.421	16,927
ROE	0.00948	0.0960	-0.00575	0.0182	0.0397	16,927
SBTI	0.0608	0.239	0	0	0	16,927

Panel B: Annual Regressions

VARIABLES	mean	sd	p25	median	p75	N
Ln(Rev)	23.59	2.671	21.75	23.13	25.16	4,796
Ln(EnvExp)	18.91	3.141	16.65	18.64	21.16	1,084
EnvExp/Rev	0.00962	0.0176	0.00105	0.00348	0.0109	1,092
Ln(Co2 Emi)	12.49	2.597	10.91	12.50	14.18	3,826
Ln(Co2 Emi/Rev)	3.898	2.117	2.550	3.724	5.401	3,820
post	0.500	0.500	0	0.500	1	4,796
HighExpo	0.141	0.348	0	0	0	68,399
ERisk	7.549	6.229	2.430	6.160	11.52	4,796
Grisk	7.617	2.338	5.960	7.340	8.950	4,796
Srisk	0.0440	1.025	-0.669	-0.0446	0.669	4,796
Ln(MCap)	24.359	2.409	22.601	23.901	25.928	4,796
Leverage	0.299	0.185	0.159	0.298	0.420	4,796
ROE	0.00963	0.0962	-0.00474	0.0185	0.0396	4,796
SBTI	0.0303	0.172	0	0	0	68,399

This table shows summary statistics for the baseline real effects regressions. **Definition of the variables**. All the variables are defined at the firm-level. Panel A reports variables for quarterly regressions (sample period: 2020Q2 to 2021Q4). Panel B reports variables for annual regressions (sample period: 2020-2021). Ln(K) is the natural logarithm of physical capital, defined as net property plants and equipment (NPPE). HighExpo is a dummy value with value 1 for firms with Expo greater or equal to 1%, and with value 0 otherwise. ERisk is the Sustainalytics environmental-risk score as of February 2021. SRisk is the Sustainalytics social-risk score as of February 2021. GRisk is the Sustainalytics governance-risk score as of February 2021. Ln(MCap) is the natural logarithm of a firm stock market capitalization as of February 2021. Leverage is the ratio between total debt and total assets as of June 2020. ROE is the ratio between net income and equity as of June 2020. SBTi is a dummy variable with value 1 for firms committed to SBTi as of February 2021, and with value 0 otherwise.

TABLE A5: DIFFERENCES BETWEEN TREATED AND CONTROL FUNDS BEFORE AND AFTER THE MATCHING PROCEDURE

	Before matching			After matching		
Variable:	Light green funds	Brown funds	Stand. diff.	Light green funds	Brown funds	Stand. diff.
Size decile	6.32	4.95	1.37	6.46	5.95	0.50
MSRating	2.28	1.80	0.48	2.56	2.40	0.16
Age	12.37	10.69	1.67	12.91	12.20	0.71
MSSustRating	3.50	3.09	0.40	3.47	3.28	0.19

The table shows the standardized differences in means of variables before and after the nearest neighborhood caliper matching approach. Light green funds are treated units, while brown funds are untreated ones. We take only 1 nearest neighbor and we apply a 0.2 caliper. We account for fund characteristics in February 2021: *MSRating*, *Age*, *MSSustRating*, size decile, Morningstar's Global Category, and domicile.

TABLE A6: THE SFDR IMPACT ON FUNDS' PORTFOLIO REALLOCATION OVER TIME BY ADOPTING A MATCHED SAMPLE

Dependent variable:	Ln(Q)		
Sample:	6 months	9 months	12 months
	(1)	(2)	(3)
LightGreen * Post * ESGRisk	-0.0018***	-0.0017***	-0.0017***
	(0.0005)	(0.0004)	(0.0005)
Controls	Yes	Yes	Yes
Fund-Security FE	Yes	Yes	Yes
Fund-Time FE	Yes	Yes	Yes
Security-Time FE	Yes	Yes	Yes
Adj. R-squared	0.9621	0.9558	0.9538
Observations	1340529	1936794	2211293

The table shows the effects of the SFDR on equity funds portfolio allocation across stocks with different exposure to ESG risk by adopting a matched sample of light green fund. Specifically, we improve comparability across light green (treated) funds and brown ones by estimating a propensity score matching by employing the nearest neighborhood caliper matching approach, by accounting for fund characteristics in February 2021: *MSRating*, *Age*, *MSSustRating*, size decile, Morningstar's Global Category, and domicile. The dependent variable is $Ln(Q)$, i.e. the log-quantity of security i held by fund j in month t. In columns (1)-(3) we examine the average active rebalancing in each fund portfolio, respectively, over 6, 9, and 12 months after the SFDR entry into force. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. *ESGRisk* is the firm-level ESG risk score. The sample period starts in September 2020 and ends in August 2021. Standard errors are double clustered at the fund-security level. *** p<0.01, ** p<0.05, * p<0.1.

TABLE A7: THE SFDR IMPACT ON FUNDS' PORTFOLIO REALLOCATION TAKING INTO ACCOUNT THE ASSET MANAGEMENT COMPANY

	Ln(Q)
	(1)
LightGreen * Post * ESGRisk	-0.0011***
	(0.0004)
DarkGreen * Post * ESGRisk	0.0004
	(0.0011)
Controls	Yes
Asset manager*Post*ESGRisk	Yes
Fund-Security FE	Yes
Fund-Time FE	Yes
Security-Time FE	Yes
Adj. R-squared	0.9620
Observations	2248656

The table shows the effects of the SFDR on equity funds portfolio allocation across stocks with different exposure to ESG risk. Relatively to the baseline results, we include here a fixed effect for each asset management company interacted with *Post* and *ESGRisk*. The dependent variable is $Ln(Q)$, which is the log-quantity of security i held by fund j in month t. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. *DarkGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 9 mandate. The sample period is September 2020-August 2021. Standard errors are double clustered at the fund-security level. *** p<0.01, ** p<0.05, * p<0.1.

TABLE A8: THE SFDR IMPACT ON FUNDS' SUSTAINABILITY RATING, INFLOWS AND EXCESS RETURNS BY ADOPTING A MATCHED SAMPLE

Dependent variable:	Green Globes	Net Flows	Norm. Flows	Excess returns
	(1)	(2)	(3)	(4)
Post * LightGreen	0.0422***	0.0020***	1.1547*	0.0009
	(0.0093)	(0.0006)	(0.6275)	(0.0121)
Controls	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes
Category-Time FE	Yes	Yes	Yes	Yes
Size Decile-Time FE	Yes	Yes	Yes	Yes
Domicile-Time FE	Yes	Yes	Yes	Yes
Adj. R-squared	0.8300	0.3844	0.4053	0.6035
Observations	44564	43800	41547	35751

This table shows the influence of the SFDR on fund-level sustainability rating, inflows and excess returns by adopting a matched sample of light green funds. Specifically, we improve comparability across light green (treated) funds and brown ones by estimating a propensity score matching by employing the nearest neighborhood caliper matching approach, by accounting for fund characteristics in February 2021: *MSRating*, *Age*, *MSSustRating*, size decile, Morningstar's Global Category, and domicile. In column (1) the dependent variable is *GreenGlobes*, a dummy equal to 1 when the fund has a Morningstar sustainability rating greater than 3 globes, as the dependent variable. In column (2), the dependent variables is $NetFlows$, the ratio between monthly net flows of fund j and its lagged TNA. In column (3), the dependent variable is $NormFlows$, i.e. normalized fund flows (Hartzmark & Sussman 2019). The dependent variable in column (4) is *ExcessReturns*, which is equal to monthly risk-adjusted returns of fund j. *Post* is a dummy variable with value 1 from March 2021 onward, and with value 0 before. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. Controls include *MSRating*, *Age*, *MSSustRating*, $NetFlows$ (in columns 1 and 4), and the level of the related dependent variable in February 2021. The sample period starts in September 2020 and ends in August 2021. Standard errors are clustered at the fund level. *** p<0.01, ** p<0.05, * p<0.1.

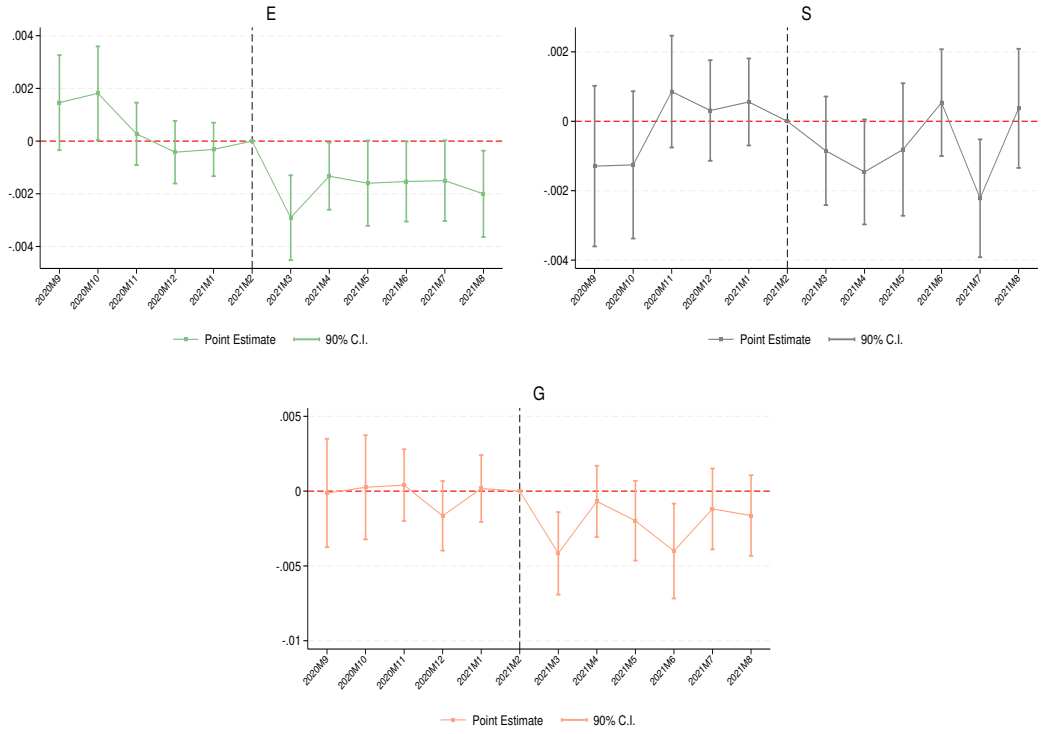
TABLE A9: SFDR-EXPOSURE, ESG RISK AND REAL EFFECTS

	Ln(K)	Ln(Rev)	Ln(EnvExp)	EnvExp/Rev	Ln(Co2 Emi)	Ln(Co2 Emi/Rev)
	(1)	(2)	(3)	(4)	(5)	(6)
Post*High-Expo*E-Risk	-0.00288a	-0.000910	-0.00771	-0.00764	0.00563	0.0100**
	(0.00196)	(0.00282)	(0.0124)	(0.0123)	(0.00407)	(0.00449)
Post*E-Risk	0.00178	0.00575***	0.00702	-0.000386	-0.00169	-0.0116***
	(0.00136)	(0.00129)	(0.00886)	(0.00818)	(0.00321)	(0.00335)
Post*High-Expo	0.0710	-0.0411	0.0422	-0.270	0.0670	0.0196
	(0.0561)	(0.0682)	(0.317)	(0.366)	(0.120)	(0.127)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector*Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country*Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.992	0.997	0.988	0.988	0.985	0.976
Observations	26530	6428	1452	1127	5289	5280

This table shows the coefficients β_1 obtained by estimating Eq. (5) for each outcome variable. In column 1, the dependent variable is firm log capital, $Ln(K)_{i,t}$, as proxied by net property plant and equipment. We employ firm-level quarterly data on capital (from 2020m4 to 2022m12). For all other variables, we use yearly data (for 2020 and 2022). In columns (2)-(7) the dependent variable is, respectively: firm log revenues, $Ln(Rev)_{i,t}$, firm log environmental expenditure, $Ln(EnvExp)_{i,t}$, environmental expenditure over revenues, $EnvExp/Rev_{i,t}$, log total (equivalent) carbon emissions, $Ln(Co2Emi)_{i,t}$, total (equivalent) carbon emissions over revenues, $Co2Emi/Rev_{i,t}$, total water consumption over revenues, $Water/Rev_{i,t}$. In column 1, $Post_t$ is a dummy with value 1 from March 2021 onward and with value 0 otherwise. In columns 2-7, $Post_t$ is a dummy with value 1 in 2021-2022 and with value 0 in 2020. *ESGRisk* is the firm-level ESG risk score. $Expo_i$ is the share of a firm ex-ante owned by light green funds. We control for the full interaction of $Expo_i$ and the post dummy with the log market capitalization and firm-level S Risk and G Risk score. Standard errors clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1, ^{a} p<0.15.

FIGURES

FIGURE A.1: LIGHT GREEN FUNDS' PORTFOLIO REALLOCATION AROUND THE SFDR LABEL DISCLOSURE ACROSS ESG PILLARS (PERCENTAGE POINTS)

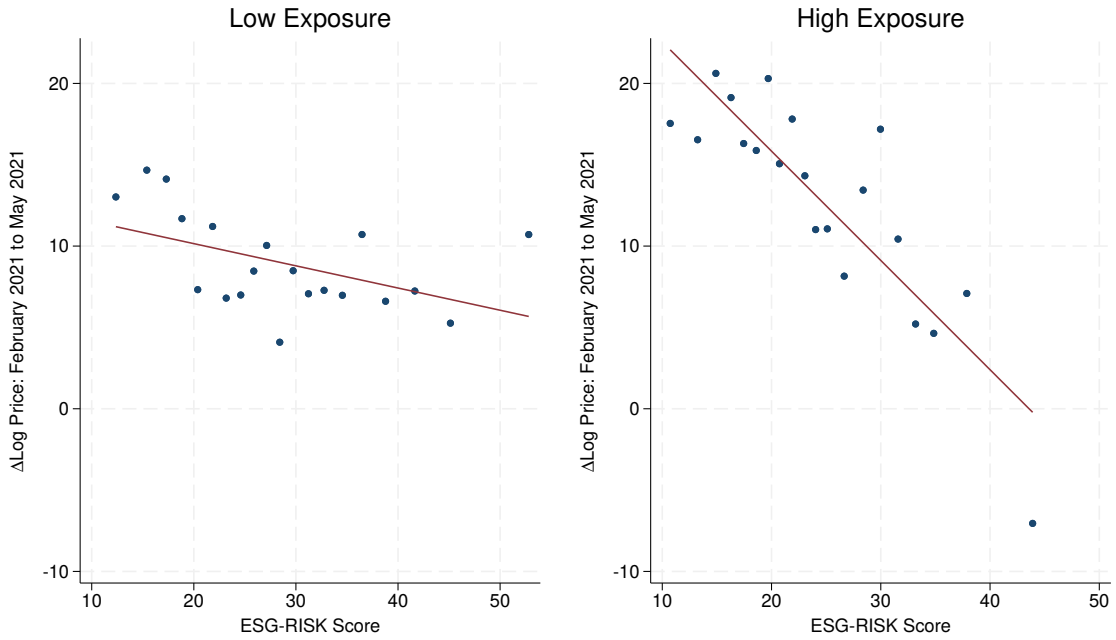


The figure shows the estimated coefficients $\hat{\beta}_{1,t}$ of the related ESG component from the following regression model:

$$Ln(Q_{i,j,t}) = \sum_{t \neq 2020m2} \beta_{1,t} * 1(year - month = t) * LightGreen_j * YRisk_i + FE + \Psi_t * \chi_{j,i,t} + u_{i,j,t}$$

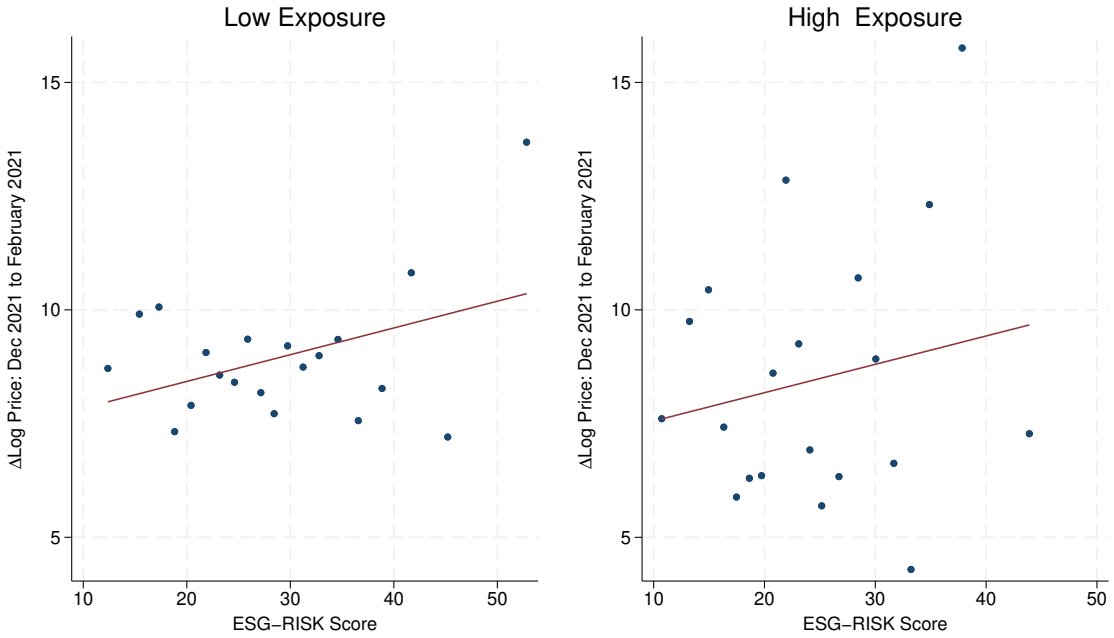
The dependent variable is $Ln(Q)$, i.e. the log-quantity of security i held by fund j in month t. *LightGreen* is a dummy variable with value 1 for funds declaring to follow ESG-investment through art. 8 of the SFDR. $YRisk$ is the vector of firm-level risk scores (*ERisk*, *SRisk*, *GRisk*). FE denotes a vector of fixed effects, including fund*security fixed effects, fund*time fixed effects and security*time fixed effects. $\chi_{j,i,t}$ is a vector of controls, including the interaction of the dark green label and of predetermined fund size and net flows $u_{i,j,t}$ with $YRisk_t$ and the time indicator functions, as well as the interaction of predetermined 3-month stock returns with the light and dark green label dummies and the time indicator functions. $u_{i,j,t}$ is an error term, double-clustered at the fund and security level. The squares report the point estimate of the coefficients $\hat{\beta}_{1,t}$. The bands around the squares depict the 90% confidence intervals.

FIGURE A.2: SFDR-EXPOSURE, ESG RISK AND STOCK RETURNS



This figure describes the relation between firm-level ex-post 6-month cumulative stock returns (y-axis) and ESG risk score (x-axis) across firms with low versus high ex-ante exposure to light green funds, $Expo_i$. The chosen threshold is 1% ex-ante exposure. Each point denotes the average ex-post return and ex-ante ESG risk score within different quintiles of the distribution of ESG risk score.

FIGURE A.3: SFDR-EXPOSURE, ESG RISK AND (EX-ANTE) STOCK RETURNS



This figure describes the relation between firm-level ex-ante 3-month cumulative stock returns (y-axis) and ESG risk score (x-axis) across firms with low versus high ex-ante exposure to light green funds, $Expo_i$. The chosen threshold is 1% ex-ante exposure. Each point denotes the average ex-post return and ex-ante ESG risk score within different quintiles of the distribution of ESG risk score.