Sustainability vs. Performance:

Impact of SFDR on Mutual Fund Flows and Performance in the European Union

Abstract

As a part of the broader climate and sustainability goals of the European Union, SFDR classifies financial products into Articles 6 (grey), 8 (light green), and 9 (deep green). Our research found that the implementation of the SFDR did not lead to an increase in capital flows for either light green or deep green funds, both in the short and long-term. Moreover, we found that the performance of light green funds, represented by Star Ratings, declined after the enforcement of SFDR. Our results suggested that, thus far, SFDR has not succeeded in increasing sustained capital flows toward sustainable investments. The policy's introduction may not have amplified the existing surge of interest in deep green funds before its implementation or drawn additional capital flow towards light green funds. The difficulty of changing investor behavior with policies through transparency focuses exists. Besides, a trade-off emerged between performance and sustainability for light green funds over time. It reflected differing investor responses based on the classification stringiness of sustainability-labeled funds.

Keywords: SFDR, Mutual Funds, Open-end Funds, Sustainable Investment.

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List of Abbreviations

Art.6	Article 6 SFDR
Art.8	Article 8 SFDR
Art.9	Article 9 SFDR
AUM	Assets under management
AUV	Accumulation unit value
CSRD	Corporate Sustainability Reporting Directive
DID	Difference-in-Differences technique
ESAs	European Supervisory Authorities
ESG	Environmental, Social, and Governance
EU	European Union
FMPs	Financial Market Participant
PAI	Principal Adverse Impacts on Sustainability Factors (Art. 4 SFDR)
RTS	Regulatory Technical Standards
SFAP	Sustainable Finance Action Plan
SFDR	Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector (Sustainable Finance Disclosure Regulation)
SRI	Socially Responsible Investing
SVD	Singular Value Decomposition
VIF	Variance Inflation Factor

1. Introduction

The European Commission introduced the Sustainable Finance Action Plan (SFAP), initiated in 2018 as a strategic framework to integrate sustainability into the financial system. This calls for an urgent need to address climate change and resource depletion and shift toward sustainable investments as the finance sector serves and plays a pivotal role in this necessary transition to a greener economy (European Commission, 2018a). The Sustainable Finance Disclosure Regulation (SFDR) is an official regulatory framework by the European Union to align financial markets with the Paris Agreement and achieve the EU's carbon neutrality by 2050 (European Commission, n.d.). It seeks to enhance transparency, combat greenwashing, and ensure that financial products marketed as sustainable adhere to sustainable practices (European Commission, 2018a; European Commission, 2018b).

The SFDR addresses the growing need for consistent and reliable information in sustainable finance by classifying financial products (European Commission, 2019c; ESMA, 2024). Funds are categorized into three different classifications based on their sustainability commitments. The first is, Article 6 which includes financial products that do not have specific sustainability objectives and are not marketed as sustainable, serving as a baseline for comparison in this thesis. The second is Article 8 funds, often called “light green”, and they include financial products that promote environmental and/or social characteristics where sustainability is not their primary objective. The third is Article 9, “deep green” funds, which focus on achieving specific environmental or social goals and are the highest sustainability standards under the SFDR. Therefore, the SFDR initiative mandates financial market participants such as fund managers to disclose how they integrate sustainability risks into their investment approach. (European Commission, 2023a; Official Journal of the European Union, 2019; European Green Deal, 2023; UN Environment Programme, 2023; LSFI, 2024; BNP Paribas, 2023)

Our thesis discusses whether SFDR’s regulatory policy could potentially impact mutual funds on capital flow in the EU market. Capital flow is essential to drive economic growth and support sustainable development. Efficient capital flow enhances market transparency and investor confidence, aligning financial systems with global sustainability goals (European Commission, 2019c). Our contributions show that SFDR’s implementation did not positively change the

capital flows for either Article 8 or Article 9 funds, whether in the short or long-term. In contrast, a downward trend in Article 9's capital flows was observed in the long run. Furthermore, we found that Article 8 funds experienced a slight degradation in Star Ratings caused by SFDR's introduction. This suggests a trade-off between performance and sustainability in light green funds, whereas deep green funds did not show the same trend.

During our analysis, we empirically examined the data from multiple entities (i.e., funds) over time using panel regression, allowing us to analyze cross-sectional and time-series variations. This method estimates relationships between variables by pooling data, assuming these relationships remain consistent across entities and time (Wooldridge, 2020; Baltagi, 2021).

The rest of this thesis is organized as follows: Section 1 begins with the introduction. Section 2 presents the literature review. Section 3 introduces the hypotheses. Section 4 outlines the methodology used as well as the data collected and processed. Section 5 presents the empirical results and discusses these findings. Finally, Section 6 discusses implications, draws conclusions, and provides several suggestions for future research.

2. Literature review

2.1 Introduction to Sustainable Finance in the EU

Sustainable finance consists of environmental and social considerations. Environmental considerations refer to both the broad sense of climate change adaptation and mitigation and the environment-related risks such as natural disasters. Social considerations relate to inequality, inclusiveness, and investments in human capital and communities. In 2018, the EU introduced a strategic finance plan named SFAP, which connects finance with the broader climate and sustainability goals, including the European Green Deal. Specifically, The SFAP's three primary objectives are (1) to reorient capital flows toward sustainable economic activities, (2) to manage financial risks associated with climate change, and (3) to foster transparency and long-term thinking in financial and economic activities. The following objectives are hereby translated into measurable steps. (European Commission, 2018a; European Commission, 2018b; Busch, 2023; ESMA, 2024)

The Sustainable Finance Directive Regulation (SFDR) 2019/2088, as part of the SFAP, enforced in March 2021, aims to increase accountability and transparency in sustainable finance (European Parliament and Council, 2019). The financial intermediaries, such as asset managers and financial advisors, are required under the SDFR to disclose sustainability information in their investment decisions. This regulation establishes a comparable and consistent approach to suitability disclosure information by classifying funds.

Regulators classify these financial products into Articles 6, 8, and 9 based on their level of sustainability commitment (European Commission, 2019c; European Commission, 2022b; ESMA, 2020; ESMA, 2024). For example, Article 6, "grey products," represents funds that do not integrate sustainability, while Article 8 is financial products that aim to promote sustainable investment, often called "light green". Article 9 is the "deep green," whose main objective is sustainable investments positively impacting the environment and society, meaning it qualifies as a more ambitious sustainable investment than Article 8 (Busch, 2023; Catherine, 2021). To further understand the articles, Appendix 2 summarizes the SFDR's disclosure requirements according to the research (Bengo et al., 2022).

Moreover, the classification helps investors understand to what extent sustainability is integrated into financial products, aiming to reduce “greenwashing” risks by setting standards for fund disclosures. (Busch, 2023; European Commission, 2018a) The primary objective of EU regulations concerning SFDR is to equip investors with the information needed to make informed investment decisions (Catherine, 2021).

2.2 SFDR's Institutional Context and Timeline

SFDR was drafted by the European Commission in 2018 as part of a broader effort to regulate sustainable finance. It complements both the EU Taxonomy and the Corporate Sustainability Reporting Directive (CSRD) to create a comprehensive regulatory framework for sustainable finance. Following the discussions and amendments in November 2019, the SFDR was formally adopted by the European Parliament and the Council of the European Union (European Commission, 2019a). The adoption established a unified framework for sustainability-related disclosures across the EU financial sector. The regulation was published in the Official Journal of the European Union on December 9, 2019, and was formally enacted 20 days later (European Commission, 2019b). The publication established the legal foundation for the SFDR’s later implementation stages.

On March 10, 2021, Level 1 disclosure requirements of SFDR came into effect, and the initial obligations mandated financial market participants (FMP), such as mutual fund managers and financial advisers, to disclose information on how they incorporate sustainability risk into their investment decisions (European Commission, 2021). Between 2020 and 2021, the European Supervisory Authorities (ESAs) developed Regulatory Technical Standards (RTS) to give more detailed guidance on the content, methodology, and presentation of the information required under the SFDR. The purpose of this was to ensure consistency and comparability of sustainability-related disclosures. In July 2022, the RTS were approved by the European Commission European Commission (2022a) which provided financial market participants (FMPs) with the necessary standards to adhere to the detailed SFDR's disclosure requirements. The Level 2 standards specified in the RTS went into effect on January 1, 2023, introducing more detailed and standardized reporting obligations, including the disclosure of principal

adverse impacts (PAI) and the sustainability characteristics of financial products (European Commission, 2023b).

In order to ensure that the regulation effectively meets its objectives of enhancing transparency and promoting sustainable investment practices, the European Commission and the European Space Agency (ESA) continue to monitor and assess the SFDR implementation throughout 2023 and 2024 (European Commission, 2023–2024).

2.3 Information Asymmetry and ESG Ratings

One study conducted by Candelon et al. (2021) has shown that asset managers often use ESG-related fund names to make it easier for investors to know the fund's characteristics. However, these ESG characteristics of the mutual fund are not proven with concrete sustainable investment practices. The misleading names of mutual funds and fund managers can influence investor behavior and perception. They refer to this practice as ESG-washing because managers' behaviors concern the environment and all dimensions of ESG. Their results imply that adequate disclosure regulation is required in the socially responsible investment (SRI) market to reduce these information asymmetries (Candelon et al., 2021). Specifically, the same study mentions how European mutual funds adopt ESG-friendly names without really focusing on ESG in their investment strategies. It also suggested that ESG branding in European mutual funds may be more of a marketing tactic to attract investors rather than reflecting a meaningful shift in the fund's investment strategy or performance (Candelon et al., 2021). This called for stringent regulations to prevent funds from misleading investors regarding ESG. However, even after one month after SFDR implementation April 2021, Bioy (2021) mentions that approximately 23-24% of European mutual funds were classified as "green" which was notably higher than expected prior to the implementation of SFDR. The unexpected surge in funds adopting green classifications may be attributed to ambiguities in the regulation's definitions and classifications.

The literature shows that the divergence between fund managers' statements and rating agencies' scores further complicates the efforts to evaluate the ESG performance of companies and funds (Candelon et al., 2021). Companies become less incentivized to enhance their ESG performance (Berg et al., 2019). This highlights the need for regulatory frameworks to

standardize sustainability reporting. As Berg et al. (2019) point out, harmonizing ESG disclosure would provide a foundation of reliable data to compare ratings.

2.4 The Effect on Fund Flows

Hartzmark and Sussman (2019) examine how sustainability ranking affects fund flows to understand how investors respond to sustainability information. According to their findings, investors value sustainability, and higher ESG rankings can attract positive fund flows, while lower rankings or low ESG scores can lead to outflows. They used Morningstar's introduction of sustainability ratings as a natural experiment where Morningstar's sustainability rating (globe rating) feature for mutual funds provided a new, standardized measure of sustainability. The empirical results explain how investors react to new information on sustainability, where sustainability can significantly influence investment decisions with potentially reaching effects on asset prices and corporate policies. (Hartzmark and Sussman, 2019; Berg et al., 2019). Some researchers argue that mutual funds that invest according to ESG rating experience significant inflows, according to Hartzmark and Sussman (2019). Recent research by Gantchev et al. (2023), among US funds found that after the introduction of the Morningstar Rating, investors drew significant attention and directed flows toward highly rated ESG funds.

2.5 Trade-offs between Sustainability & Financial Performance

Pollman (2022) points out the source of challenges when examining the trade-offs between sustainability initiatives and financial performance. One is the inconsistent ESG metrics and varying definitions of what constitutes ‘sustainable’ practices. Another is that sustainability initiatives often require a long-term perspective, but financial markets frequently operate on a short-term perspective, which leads to uncertainty about whether investing in ESG yields financial returns. Starks (2022) identified the conflict between investors who see ESG as a way to achieve financial returns and those who focus on ethical considerations that reflect their personal or societal beliefs. Some investors aim to use ESG to manage long-term risks and improve returns, while others are willing to accept lower financial gains to support social and environmental goals. Starks (2022) elaborates that financial returns and sustainability can coexist, but tensions may arise when differentiating between them.

Furthermore, the article by Gantchev et al. (2023) highlights that the poor performance associated with sustainability-focused investments is not due to the quality of stocks, such as value, size, or ESG ratings. Instead, it is because of the changes in strategies driven by sustainability goals. Their results showed long-term trade-offs returns vs. sustainability, implying that solely focusing on high ESG is insufficient to maintain investors if they equate to lower financial returns. Hartzmark and Sussman's (2019) findings demonstrate the initial attraction to high-rated ESG funds, followed by a significant shift back to performance-focused investing within mutual funds. Another study by Geczy et al. (2021) further suggests that socially responsible funds may sacrifice some financial returns to adhere to their ESG criteria.

2.6 Contribution to the current literature

As illustrated above, extensive research involved information asymmetry, greenwashing, the divergence of ESG rating, and the regulator's gaps contributing to the dysfunction. (Berg et al., 2019; Hartzmark and Sussman, 2019). Several studies have shed light on the role of regulatory frameworks in the EU in addressing transparency issues. Yet, there is limited empirical work in Europe to address how SFDR classifications influence capital flows. This paper contributes to the discourse by filling some of the voids concerning whether there are any trade-offs between sustainability and performance in the European context.

3. Research Hypotheses

3.1 Hypothesis 1 regarding Fund Flow Long-term

Previous research highlights the general impact of sustainability-focused regulations where increased transparency in ESG disclosures attracts higher investment inflows (Amel-Zadeh and Serafeim, 2018). Investors will find it easier to differentiate between funds featuring varying levels of sustainability integration due to the SFDR classification framework that categorizes funds. This categorization is expected to funnel more capital into sustainable investment options, enhancing the attractiveness of funds that prioritize ESG criteria.

However, whether SFDR affects the reallocation of capital in the EU market remains a topic of exploration in the long-term, especially given regional and investor-specific differences in ESG priorities (Kölbel et al., 2020). We will examine the long-term trend in green fund flows before and after implementing SFDR. We aim to identify possible significant shifts in capital flows in the long-term (September 2017- August 2024).

Hypothesis 1 (H1): From September 2017 to August 2024, the introduction of SFDR has led to increased net capital flows into funds classified under Article 8 and Article 9 compared to Article 6 (non-sustainable) funds.

3.2 Hypothesis 2 regarding Fund Flow Short-term

Some articles highlight that SFDR labels effectively channel more capital flows into Article 9 funds since they associate it with higher sustainability standards and clear sustainable investment objectives (Scherer and Hasaj, 2023). Article 8 funds are perceived to have less stringent sustainability commitments, especially as they are often associated with greenwashing (Bodellini, 2023; Fricke and Schlepper, 2024; MSCI, 2021). We aim to ascertain whether this trend remains consistent over the short timeframe. In the second hypothesis, we aim to examine how the impacts of the SFDR on capital flows differ or align between Articles 8 “light green” and 9 “deep green”, in the short-term (immediate effects). We define the short-term period as from January 2019 to December 2022, with March 2021 serving as a threshold of the implementation of SFDR.

Hypothesis 2 (H2): In short-term, Article 9 funds will attract more capital flow than 8 due to their perceived higher sustainability standards.

3.3 Hypothesis 3 regarding Performance vs Sustainability

The previous research indicates a tension between financial gains and sustainability values, according to Starks (2023). Gantchev et al. (2023) also found that US mutual funds increased their investments in sustainable stocks to enhance their sustainability ratings. However, they noted that those funds that succeeded in improving their sustainability ratings experienced decline in performance where Gantchev et al. (2023) observed trade-off between sustainability and performance. Previous research findings provide a foundation for investigating how the SFDR influences these emerging trade-offs and conflicts. In our third hypothesis, we analyze how the SFDR impacts performance in short and long-term performance. Then, we examine if there are trade-offs between performance and sustainability across two timeframes, leading us to our third hypothesis.

Hypothesis 3 (H3): The introduction of SFDR influences the performance of articles 8 and 9; Especially in Article 8, a negative trade-off arises between performance and sustainability.

4. Data

4.1 Data Source & Sample Selection

Our empirical analysis uses Morningstar Direct data focusing on EU-domiciled open-end funds from 2017 to 2024. Morningstar Direct provides cross-sectional data on each fund's SFDR classification where funds are labeled as Art. 6 (“not stated”), Art. 8, or Art. 9. The dataset includes fund classifications (Article 6, Article 8, and Article 9), monthly flows, returns, and TNA, enabling a comparison of treated and control groups before and after the SFDR policy. Our sample spans from 2017 to 2024. Previous studies adopt long evaluation periods, often ranging from 3 to 10 years, and this, therefore, justifies using a 7-year horizon as a balanced approach (Jensen, 1969; Dahlquist et al., 2000).

Similar to previous studies, we focus on open-end funds (Ammann et al., 2020; Białkowski and Starks, 2016; Hartzmark and Sussman, 2019; Riedl and Smeets, 2017). In 2023, the European open-end fund market was predominantly comprised of active funds (90%), which were defined as employing active management strategies (EFAMA, 2023).

We incorporate funds with at least 10 million in assets under management (Chevalier and Ellison, 1997). To ensure accuracy and insistence of funds’ performance and management approach, we only considered funds with a history that is longer than 10 years (Webster, 2002), with the inception date before 2014-08-31. Our data set consists of 9758 individual funds. Considering our 7-year time span, we draw as much time-varying data as possible, including TNA, monthly return, AUM, Star Rating, and 12-month yield. Limited by data quality from Morningstar Direct, we used the latest globe rating and SFDR classification on 2024-08-31 as entity-fixed variables to avoid the possible systematic bias from over data cleaning.

4.2 Variable Definitions

We select a series of variables that are commonly accepted as explanatory factors of risk-adjusted performance. Such variables are collected in Table 1 with descriptions from Morningstar Web Help and other academic articles.

Data Object	Description
TNA	Stands for the Total Net Assets, the value of a mutual fund that is calculated by the total assets minus its liabilities (Morningstar, n.d.).
Monthly Return	The monthly percentage change in accumulation unit value (AUV) of a mutual fund, divided by starting AUV (Morningstar, n.d.).
Fund Size	Stands for the Assets Under Management, the total market value of a mutual fund managed by its manager or managing team.
Beta	A metric used to reflect a mutual fund's risk level based on historical performance. Measured by the sensitivity of the fund's return to changes in the market (Parameswaran, 2022).
Alpha	The overall excess return of a mutual above S&P 500 index fund after risk adjustment (Lin et al., 2023).
Volatility	Stands for the standard deviation of return during a period (Jordan and Riley, 2015).
Turnover Ratio	The percentage of mutual fund holdings that have been replaced in one year (Morningstar, n.d.).
Expense Ratio	The rate of a mutual fund's annual operating cost, calculated by its assets (Vanguard, n.d.).
Sortino Ratio	The risk-adjustment metric of performance when only takes downside volatility into consideration (Chen, Yang, and Peng, 2014).
12 Month yield	The metric of mutual fund's income distribution, including interest from fixed-income securities and dividends from stocks (Morningstar, n.d.).
Star Rating	The metric of mutual fund's past performance compared with similar funds, ranges from 1 (worst) to 5 (best), issued by Morningstar, Inc (Morningstar, n.d.).
Globe Rating	The metric of mutual fund's ESG credentials, compared with similar funds, ranges from Low (worst) to High (best), issued by Morningstar, Inc (Morningstar, 2019). For ease of analysis, we converted them into 1-5 scores.

Table 1. Variable Definitions and Descriptions

4.3 Data Transformation and Fund Flow Calculation

Following Sirri and Tufano's (1998) approach, we define the monthly net capital flow as the rate of change in total net assets (TNA) adjusted by reinvested returns:

$$Flow_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1} * (1 + R_{i,t})}{TNA_{i,t-1}} \quad (1)$$

$TNA_{i,t}$ And $TNA_{i,t-1}$ represent the total net assets of mutual fund i at the end of month t and t-1 separately. $R_{i,t}$ represents the monthly return reported at the end of month t.

This model assumes that the possible capital input and output caused by investor behavior always and only occurs at the end of each month, and dividends are fully reinvested (Renneboog et al., 2011; Ammann et al., 2020). $TNA_{i,t-1} * (1 + R_{i,t})$ reflects the total net asset value right before the additional capital flow in month t. The key assumption in this metric is that fund flows reflect investor decisions independent of market-driven growth or reinvested dividends. It focuses on the net change in fund size due to capital inflows or outflows, similar to those of Renneboog et al. (2011), Ammann et al. (2020), and Sirri and Tufano (1998).

4.4 Characteristics of the sample

We provide the geographical distribution of the samples' domicile and investment area. Figure 1 shows the domicile information: most mutual funds in our sample are orientated in Luxembourg, followed by Ireland and France. This sample character matches the statistics result issued by PwC Luxembourg (2024). One noteworthy point is that when comparing horizontally among three articles, the proportions of mutual funds involved in each Article in Luxembourg grow with the ESG level increases, from 77% in Article 6 to 91% in Article 9, when taking the SFDR category as the ESG benchmark.

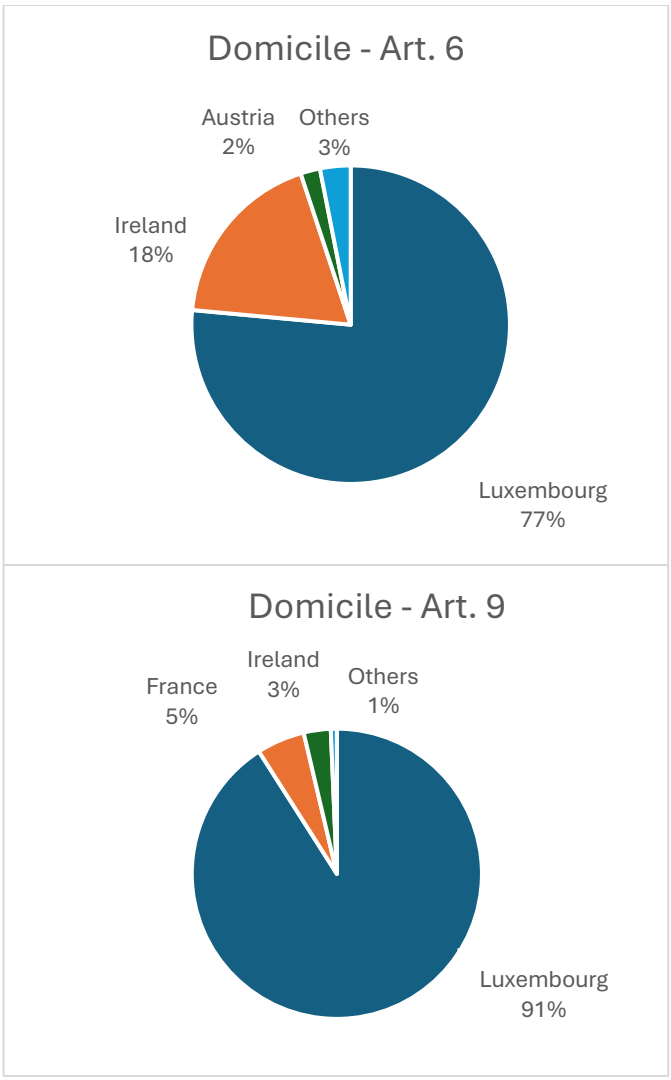


Figure 1: Mutual funds distribution by Domicile. The top 3 countries in each article.

Regarding the investment area – the geographical region the mutual fund holding focuses on - Figure 2 highlights that global investment is the most welcomed option regardless of SFDR classification. Moreover, Article 9 funds concentrate more on European markets – Euroland 10%, Europe 9% - and less on global emerging markets – 15% in Article 6, 13% in Article 8, but only 2% in Article 9. It also indicates that the traditional non-ESG funds - including Article 6 and Article 8 – show a similar geographical strategy, such as participating in US and APAC markets.

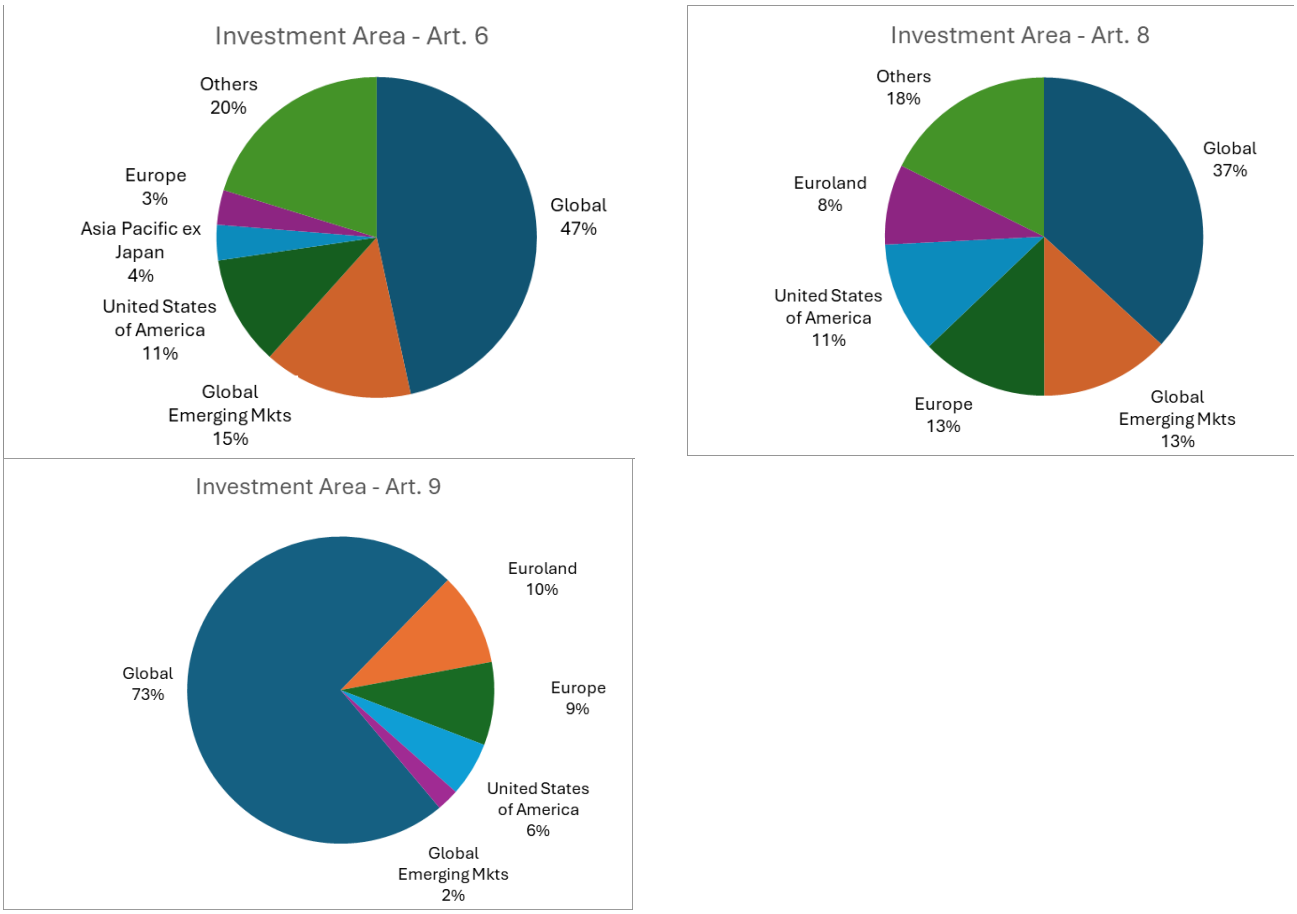


Figure 2: Distributions of top 5 Investment Areas in each Article.

In our sample, SFDR classification shows strong connections with Globe Rating (Figures 3 and 4). Article 8 funds are distributed similarly to Article 6 non-ESG funds, while they are slightly skewed toward higher Globe Ratings. Article 9, in contrast, is concentrated on high performance, such as Above Average and High, while a small portion of funds still lie in the low Globe Rating grades.

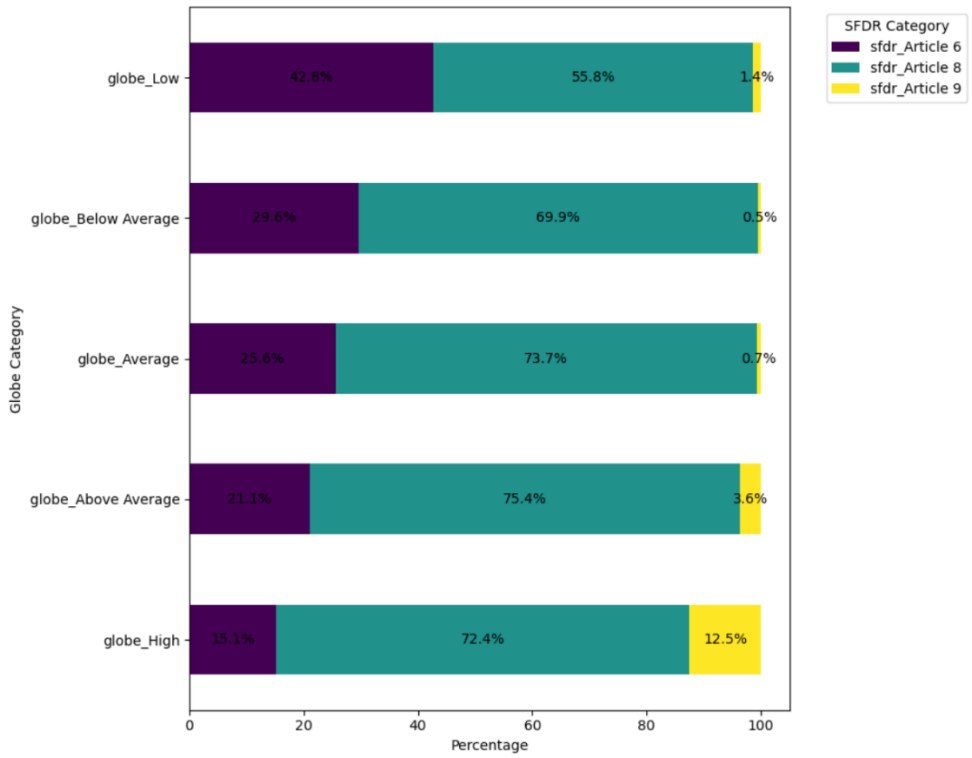


Figure 3. Distribution of SFDR classes grouped by Globe Rating grades

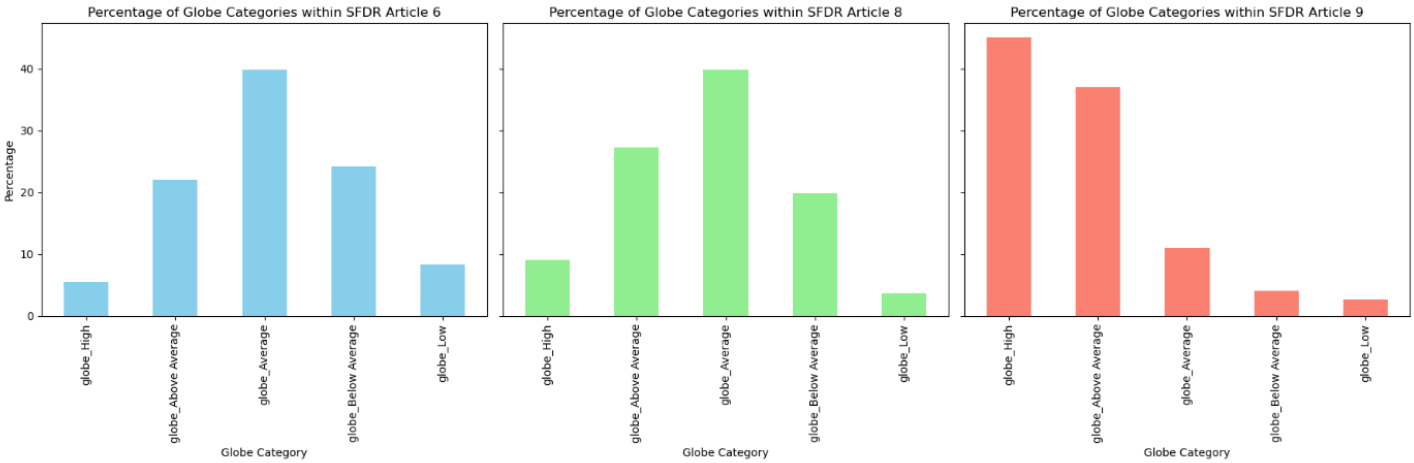


Figure 4. Distribution of Globe Rating grades grouped by SFDR classes

5. Methodology

We use a panel regression model with two-way clustering (Cameron and Miller, 2015; Petersen 2009). Given the panel nature of our dataset, which comprises information about multiple mutual funds(entities) over multiple periods, the two-way clustering addresses our data structure. Observations within the same mutual fund may show entity-level correlation due to ongoing fund-specific characteristics, such as management style, investment strategies, or classification (Articles 6, 8, or 9 under SFDR). This method also considers the time-level correlation. Mutual funds tend to show similar trends during the same period, for example the macroeconomic shocks may introduce common time volatility across entities. The two-way clustering accounts for both dimensions and ensures a robust and reliable analysis.

As a quasi-experimental approach, Difference-in-Differences (DID) methodology allows us to isolate the causal effect of SFDR while controlling for other factors that may influence fund flows, which is very useful for ex-post impact evaluation when discussing the activation of law and policy (Dunbar et al., 2023; Dreepaul-Dabee and Tandrayen-Ragoobur, 2022; Zhou et al., 2016; Card and Krueger, 1994).

5.1 DID Model to Estimate the Effect of SFDR Policy on Fund Flows

We start by estimating the causal effect of the SFDR policy on funds. In the DID approach, the treatment group consists of Article 8 or 9 funds, subject to SFDR, while the control group always consists of Article 6 funds, which are not directly affected by the policy.

We conduct a panel regression model based on equation 2.

$$\begin{aligned} Flow_{i,t} = {} & \beta_0 + \beta_1 * SFDR_i \times Post_t + \beta_2 * SFDR_i + \beta_3 * Post_t + \beta_4 \\ & * \ln(TNA_{i,t}) + \beta_5 * Returns_{i,t} + \beta_6 * \ln(AUM_{i,t}) + \beta_7 \\ & * Beta_i + \beta_8 * Volatility_i + \beta_9 * Alpha_i + \beta_{10} \\ & * Turnover\ ratio_i + \beta_{11} * Expense\ ratio_i + \beta_{12} \\ & * Sortino\ ratio_i + \beta_{13} * 12\ Mo\ Yield_{i,t} + \beta_{14} * Star_{i,t} + \beta_{15} \\ & * Globe_i \end{aligned} \tag{2}$$

The dependent variable $Flow_{i,t}$ represents the additional monthly capital flow of a fund after 100% dividend reinvestment. We calculated it with two time-varying variables $TNA_{i,t}$ and $Returns_{i,t}$ by Equation 1. To reduce the outliner effect, we trim the monthly capital flow at the 5th and 95th percentile (Sirri and Tufano, 1998). SFDR is a binary variable that is equal to 1 for funds classified as Article 8 or 9, depending on the corresponding treatment group. $Post_t$ is a binary variable indicating the status of SFDR regulations activated in March 2021. It is equal to 1 in the month when SFDR regulation existed. $SFDR_i \times Post_t$ is the key interaction variable capturing the causal effect of SFDR. By controlling covariates, we focus on the coefficients of $SFDR_i$ and the interaction variable $SFDR_i \times Post_t$ to discuss the labeling effect of SFDR classification on stimulating investors' demand.

Previous studies have proved that investors' interest and demand for mutual funds can be impacted by performance and risks (Kosowski, 2011). Therefore, we introduce a series of control variables (covariates) to further improve precision and adjust for heterogeneity. $\ln(TNA_{i,t})$ and $\ln(AUM_{i,t})$ indicate the natural logarithms of TNA and AUM separately, which are used because they typically show a right-skewed distribution (Bigelli and Manuzzi, 2019). Monthly returns in $Returns_{i,t}$, 5 years Beta in $Beta_i$, 5 years standard deviation in $Volatility_i$, 5 years Alpha in $Alpha_i$, turnover ratio, expense ratio, Sortino ratio, 12-month yield in $TTM_{i,t}$ and Morningstar Star Rating in $Star_{i,t}$ are common metrics to consider in performance-risk trade-offs (Droms and Walker, 1996). The equation 2 will be used in both Hypothesis 1 and 2. In order to discuss the difference in the SFDR effect in both short-term and long-term periods while ensuring the consistency of the results, we regulate two different research periods for each hypothesis and repeat the same regression model.

5.2 DiD Model to Estimate the Effect of SFDR Policy on Performance

$$\begin{aligned} High\ Star_{i,t} = {} & \beta_0 + \beta_1 * SFDR_i \times Post_t + \beta_2 * SFDR_i + \beta_3 * Post_t + \beta_4 \\ & * Returns_{i,t} + \beta_5 * Beta_i + \beta_6 * Volatility_i + \beta_7 * Alpha_i \\ & + \beta_8 * Turnover\ ratio_i + \beta_9 * Expense\ ratio_i + \beta_{10} \\ & * Sortino\ ratio_i + \beta_{11} * 12\ Mo\ Yield_{i,t} + \beta_{12} * Globe_i \end{aligned} \quad (3)$$

Similar to the analysis of the effect of the SFDR policy on fund capital flows, we conduct the panel regression analysis with DID techniques based on Equation 3. To solve the problem of Singular Value Decomposition (SVD) not converging, we use VIF to identify and exclude TNA and AUM from independent variables.

The dependent variable $High\ Star_{i,t}$ is defined as a binary variable reflecting the Star Rating status and is considered as a metric of mutual funds with high past performance (Huang, Li, and Weng, 2020). Star Rating indicates the performance ranking of a mutual fund among its peers. It is based on the risk-adjusted return and takes expenses such as redemption fees and sales charges into account. Funds ranked in the top 10% are given five stars, and the next 22.5% are given four stars (Morningstar, n.d.). $High\ Star_{i,t}$ equals 1 if the mutual fund i gets 4 or 5 marks in Star Rating – ranking top 32.5% within categories - in month t. As a predicted variable in linear regression, it represents the possibility for fund i to perform high in month t, by the given set of independent variables. Reflecting on the definition of $High\ Star_{i,t}$, we keep metrics at risk and return as control variables. We also take Globe Rating into consideration to further support ESG metrics' effect on performance.

5.3 Multicollinearity Check

In regression models, we introduce a series of control variables in the risk and performance domains. Considering their mutual relationships, as Sortino Ratio is calculated by portfolio, risk-free rate, and standard deviation of the downside, and the Star Rating refers to the Sharpe Ratio, which has a strong correlation with the Sortino Ratio (Wang and Yan, 2021; Morningstar, n.d.; Srivastava and Mazhar, 2018), we utilize the Correlation Matrices, Correlation Heatmaps and Variance Inflation Factor (VIF) to inspect the multicollinearity (James et al., 2017).

6. Results

6.1 Hypothesis 1

6.1.1 Descriptive Results

Mean Capital Flow is defined as the arithmetic mean value of a mutual fund's capital flow in a specific period. To preliminarily demonstrate the effect of SFDR classification, we create a series of density curves for the mean capital flow of each category before or after SFDR activation. Figure 5 shows that the distribution of Article 8 funds' capital flow does not exhibit a significant difference from Article 6 funds (represented as 'Not Stated"). Meanwhile, Article 9 funds show a larger mean value than 6 and 8, demonstrating a significant advantage of deep green funds in attracting capital.

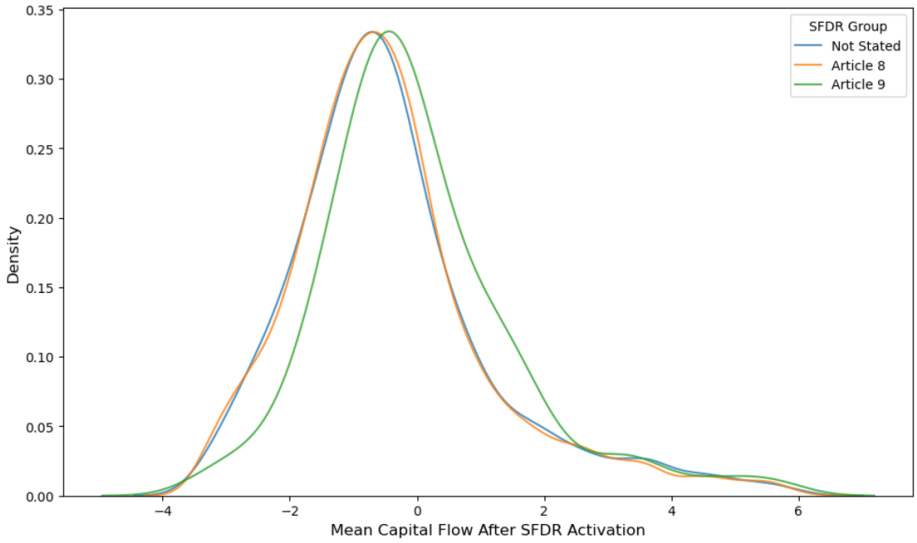


Figure 5: Density Curves of Mean Capital Flow Grouped by SFDR (After Activation)

Figure 6 shows that after activation, Article 9 funds report a noticeable decline in mean capital flow. This result hints at a clue that the effect of SFDR classification on attracting investors may be lower than expected or even negative.

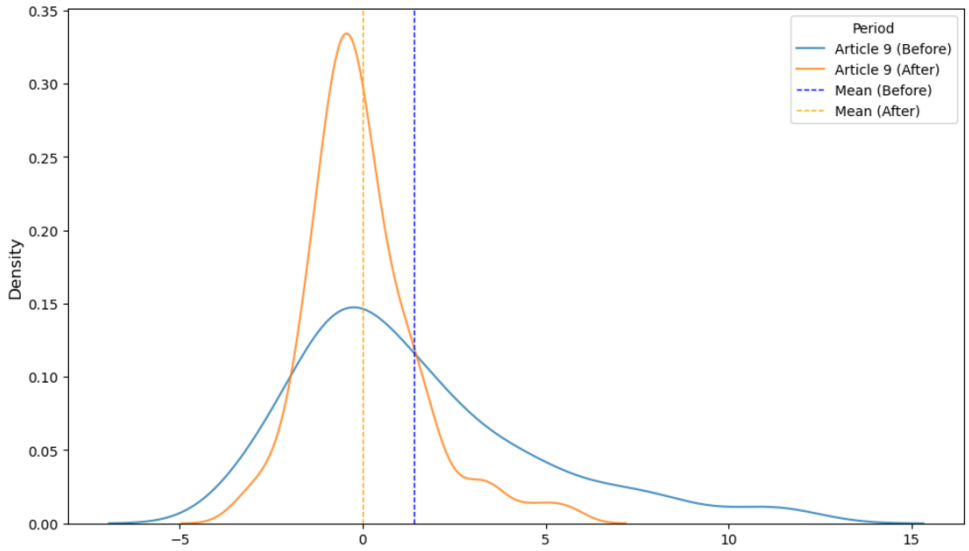


Figure 6: Density Curves of Article 9 Mean Capital Flow (After Activation)

Appendices 3 and 4 contain the rest of the density curve graphs in other Article categories in both periods.

6.1.2 Empirical Results

The panel regression provides direct evidence after mitigating the impacts of extraneous confounders and selection bias (Chamberlain, 1982). Table 2 shows the analysis results of two treatment groups: Article 8 and Article 9 funds separately, with the same control group: Article 6 (Non-ESG funds, represented as 'Not Stated' in the data frame). For each independent variable, we provide the estimate, the p-value (represented by the number of asterisks in which $p < 0.1$ = *; $p < 0.05$ = **; $p < 0.01$ = ***), and the t-value in brackets.

In Table 4, the regression only with SFDR * Post, SFDR (Art. 8 or 9), and Post provides a group of significant coefficients. Just as Kosowski (2011) pointed out, investors' interest and demand for mutual funds can be impacted by performance and risks. We refer to the model including control variables, as it reduces bias in omitted variables and has a higher over R-squared.

From the analysis result, we find that the treatment variable ($\beta_2 : SFDR$) of Article 8 is not statistically significant in explaining fund flow. It demonstrates that before the SFDR introduced the funds currently classified in Article 8 did not show any difference in fund flow from Article 6. While the treatment variable of Article 9 reports a significant and positive coefficient, which shows that those classified in Article 9 can originally draw investors' interest.

The interaction variable (SFDR * Post) represents the gap between the real and expected capital flow under the same trend assumption. It reflects the effect of the SFDR regulation on each article. The insignificant coefficient in Article 8 indicates that the introduction of SFDR does not give an observable advantage to 'light green' funds against their non-ESG peers. The significant and slightly negative coefficient in Article 9 indicates that SFDR has a negative effect on deep green funds conversely.

The Post variable shows whether there was a general change in fund flows for Article 6 funds (the control group) after the SFDR policy started. Since it is statistically insignificant, this indicates no substantial change in flows for Article 6 (non-ESG) funds after the policy. Additionally, this implies that if there are any variations in flows for Article 8 or 9, funds are likely because of the SFDR policy's specific impact on those funds (captured by the interaction term SFDR × Post) and not because of overall market trends.

Star Ratings and Globe ratings are noticeable among the control variables. The Star Ratings show a consistent pattern of significant positive effects in both Articles 8 and 9. As an overall past performance metric, the Star Ratings play an important role in supporting active investment decisions, especially compared to other performance metrics such as monthly return and 5-year Alpha.

	Monthly capital flow (%)			
	Article 8		Article 9	
	Simple	Control	Simple	Control
SFDR * Post	0.555***	0.020	0.230	-0.299**
	(10.258)	(0.608)	(1.602)	(-2.244)
SFDR (Art. 8 or 9)	-0.505***	-0.021	0.076	0.494***
	(-10.353)	(-0.814)	(0.732)	(5.297)
Post	-0.621***	-0.024	-0.600***	-0.024
	(-19.080)	(-0.504)	(-18.380)	(-0.507)
TNA (ln)		-0.033***		-0.029***
		(-8.391)		(-4.997)
Monthly Return		0.031***		0.024***
		(3.148)		(3.219)
AUM (ln)		-0.024***		-0.019***
		(-5.694)		(-2.860)
5Yr Beta		0.005		-0.131
		(0.146)		(-1.476)
5Yr Volatility		-0.004		-0.001
		(-1.244)		(-0.262)
5Yr Alpha		0.008		0.016**
		(1.484)		(2.213)
Turnover Ratio		-0.000***		-0.000***
		(-0.735)		(-3.209)
Expense Ratio		-0.055***		-0.074***
		(-3.111)		(-3.023)
Sortino Ratio		0.061		0.117**

		(1.480)		(2.476)
12 Mo Yield		-0.051***		-0.040***
		(-7.438)		(-3.832)
Morningstar Star Rating				
2 Stars		0.171***		0.195***
		(5.524)		(4.452)
3 Stars		0.418***		0.458***
		(9.751)		(8.578)
4 Stars		0.707***		0.759***
		(12.881)		(11.293)
5 Stars		1.080***		1.004***
		(15.328)		(12.502)
Morningstar Globe Rating				
2 Globes		0.058		0.008
		(1.298)		(0.108)
3 Globes		0.154***		0.143**
		(3.554)		(2.160)
4 Globes		0.166***		0.175***
		(3.657)		(2.641)
5 Globes		0.187***		0.118
		(3.495)		(1.475)
Clustered Cov. Estimator	YES	YES	YES	YES
Number of observations	590401	590401	178218	178218
R-Squared	0.036	0.060	0.024	0.061

Table 2. Difference-in-difference regression results on monthly capital flow

6.1.3 Multicollinearity Check

In correlation matrices and heatmaps (Appendix 5 and 6), we take correlation > 0.7 as the threshold for significant multicollinearity (O'Brien, 2007). The heatmap shows that all independent variables pass the tests, including 6 high-correlated variables. In Table 3, we double-check with variance inflation factors.

	Article 8	Article 9
SFDR (Art. 8 or 9)	1.047	1.343
5Yr Volatility	1.689	1.54
Sortino Ratio	1.583	1.434
Expense Ratio	1.292	1.275
Alpha	1.339	1.285
AUM (ln)	1.262	1.366

Table 3. VIF Result

We take VIF > 5 as the threshold of significant multicollinearity (James et al., 2017). The result further confirms the absence of multicollinearity in regression.

6.2 Hypothesis 2

6.2.1 Regression Results

Focusing on H2, Table 4 shows the results of the panel regression results for Article 8 and Article 9 funds in the short-term, from January 2019 to December 2022. The Adjusted R^2 value is relatively low, at 0.051 for Article 8 and 0.052 for Article 9 in the short-term, slightly lower than the long-term period indicated in Table 2. This indicates a modest explanatory power of the model, particularly when compared to long-term data.

Most importantly, the interaction variable (SFDR * Post) representing the Difference-in-Differences estimate is statistically insignificant in both Articles 8 and 9 ($p > 0.05$). It shows that the introduction of the SFDR policy did not result in a significant change in capital flows to

green funds, including light and deep green, relative to non-ESG peers after its short-term implementation. The findings underscore that the policy's impact on investor behavior across the different fund classifications, i.e., Art, 8, and 9, was negligible throughout the analyzed timeframe ($p > 0.05$).

The coefficient for the baseline difference in flows (β2: SFDR) for Article 9 funds is 0.653, which is statistically significant. This indicates that prior to the SFDR policy, Article 9 funds attracted higher capital flows compared to Article 6 funds. In contrast, for Article 8 funds, the baseline coefficient (β2: SFDR) is statistically insignificant. This result shows that there was no significant difference in flows between Article 8 funds (treated) and Article 6 funds (control) before the SFDR policy.

The post-SFDR efficient period (β3: Post) is statistically insignificant for both Art. 8 and Art. 9 when compared to Article 6 funds. This implies that there was no significant evidence of general time change affecting both the treatment groups (Article 8 or Article 9 funds) and the control group (Article 6 post-SFDR) in the short-term period. There was no measurable shift in overall capital flows across the EU market post-SFDR enactment.

	Monthly capital flow (%)			
	Article 8		Article 9	
	Simple	Control	Simple	Control
SFDR * Post	0.470***	-0.040	0.520***	0.042
	(6.116)	(-0.914)	2.910	(0.2681)
SFDR (Art. 8 or 9)	-0.428***	0.002	0.299***	0.653***
	(-6.196)	(0.050)	(2.007)	(5.296)
Post	-0.533***	0.050	-0.502***	0.044
	(-12.982)	(0.798)	(-12.024)	(0.687)
TNA (ln)		-0.026***		-0.023***
		(-4.842)		(-3.165)

Monthly Return	0.037***	0.031***
	(2.949)	(3.346)
AUM (ln)	-0.023***	-0.015*
	(-4.709)	(-1.886)
5Yr Beta	-0.067	-0.321***
	(-1.463)	(-2.735)
5Yr Volatility	-0.007*	0.001
	(-1.808)	(0.201)
5Yr Alpha	0.005	0.024**
	(1.036)	(2.497)
Turnover Ratio	-0.000*	-0.001***
	(-1.869)	(-3.898)
Expense Ratio	-0.050*	-0.057*
	(-1.936)	(-1.836)
Sortino Ratio	0.006	0.027
	(0.100)	(0.404)
12 Mo Yield	-0.056***	-0.050***
	(-6.139)	(-3.617)
Morningstar Star Rating		
2 Stars	0.179***	0.161***
	(4.294)	(2.909)
3 Stars	0.467***	0.479***
	(7.844)	(6.926)
4 Stars	0.775***	0.826***
	(10.329)	(9.147)
5 Stars	1.147***	1.088***

		(11.874)		(10.171)
Morningstar Globe Rating				
2 Globes		0.001		-0.037
		(0.011)		(-0.455)
3 Globes		0.142**		0.185**
		(2.675)		(2.300)
4 Globes		0.147***		0.178**
		(2.756)		(2.295)
5 Globes		0.235***		0.103
		(3.641)		(1.027)
Clustered Cov. Estimator	YES	YES	YES	YES
Number of observations	335981	335981	104221	104221
R-Squared	0.024	0.051	0.015	0.052

Table 4. Difference-in-difference regression results on monthly capital flow (Short term)

6.2.2 Multicollinearity Check

As in hypothesis 1, we create the correlation matrix and heatmap (Appendix 5 and 7) for independent variables and double-check the VIF of 6 key vulnerable variables with high positive correlation (Table 5).

	(A) Article 8	(B) Article 9
SFDR (Art. 8 or 9)	1.052	1.356
5Yr Volatility	1.68	1.526
Sortino Ratio	1.556	1.406
Expense Ratio	1.292	1.274
Alpha	1.33	1.275
AUM (ln)	1.271	1.389

Table 5. VIF Result

Again, we take correlation > 0.7 and VIF > 5 as the threshold. No evidence of significant multicollinearity is observed.

6.2.3 Comparison Short Term vs. Long Term

	Monthly capital flow (%)			
	Article 8		Article 9	
	(1) Short term	(2) Long term	(1) Short term	(2) Long term
SFDR * Post	-0.040	0.020	0.042	-0.299**
	(-0.914)	(0.608)	(0.2681)	(-2.244)
SFDR (Art. 8 or 9)	0.002	-0.021	0.653***	0.494***
	(0.050)	(-0.814)	(5.296)	(5.297)
Post	0.050	-0.024	0.044	-0.024
	(0.798)	(-0.504)	(0.687)	(-0.507)
Control Variables	YES	YES	YES	YES
Clustered Cov. Estimator	YES	YES	YES	YES
Number of observations	335981	590401	104221	178218
R-Squared	0.051	0.060	0.052	0.061

Table 6. Regression result comparison, short term vs. long term

Table 6 compares our analysis results for Articles 8 and 9, focusing on short-term versus long-term perspectives. The interaction term (SFDR * Post) for Article 9 shows a significant negative coefficient of -0.299 in the long-term, compared with its insignificant coefficient in the short-term. It suggests a change in SFDR's impact on deep green funds with the time frame changes. However, for Article 8 light green funds, the capital flows remain insignificant for both the short and long-term.

6.3 Hypothesis 3

6.3.1 Descriptive Results

Figures 7 and 8 separately show the distributions of Star Rating grades in each SFDR Article and the standard distribution in Star Rating definitions. By comparing these two figures, we find

that Articles 8 and 9 are more likely to get high Star Rating levels, meaning they tend to outperform compared with Article 6 grey funds. As a result, Articles 8 and 9 report more pronounced advantages in getting higher Star Rating grades, particularly Article 9.

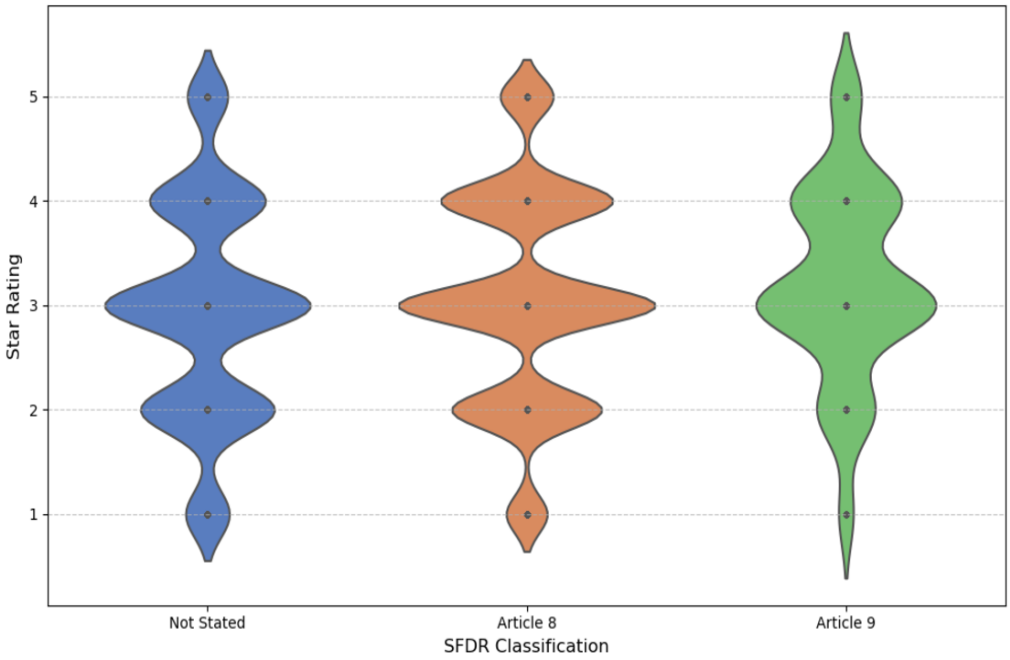


Figure 7. Violin Plots of Star Rating distribution Grouped by SFDR classification (August 2024)

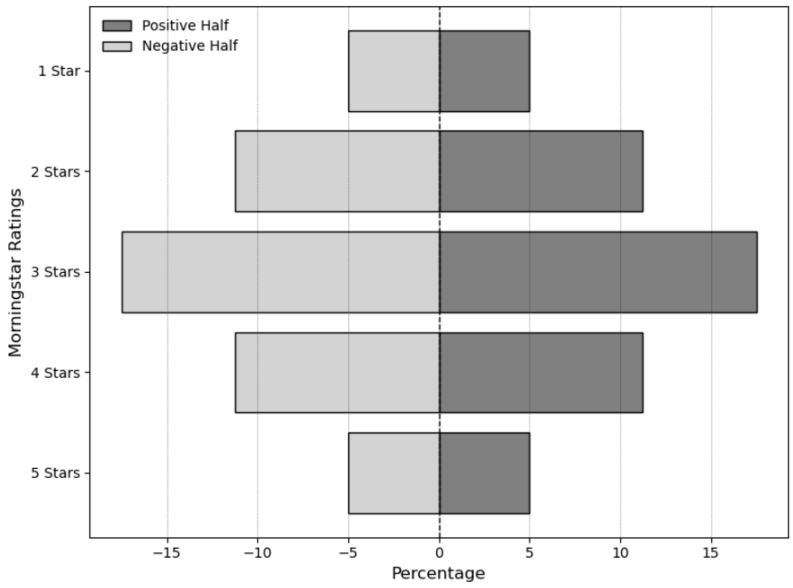


Figure 8: Standard Distribution of Star Ratings by Definition

Figure 9 below shows the distributions of another performance metric, the 5-year Alpha in density curves. It indicates the slight difference between Article 6 (represented as 'Not Stated') in comparison to Article 8 and Article 9. This figure illustrates a positively skewed distribution in Article 9, indicating that Article 9 tends to perform better.

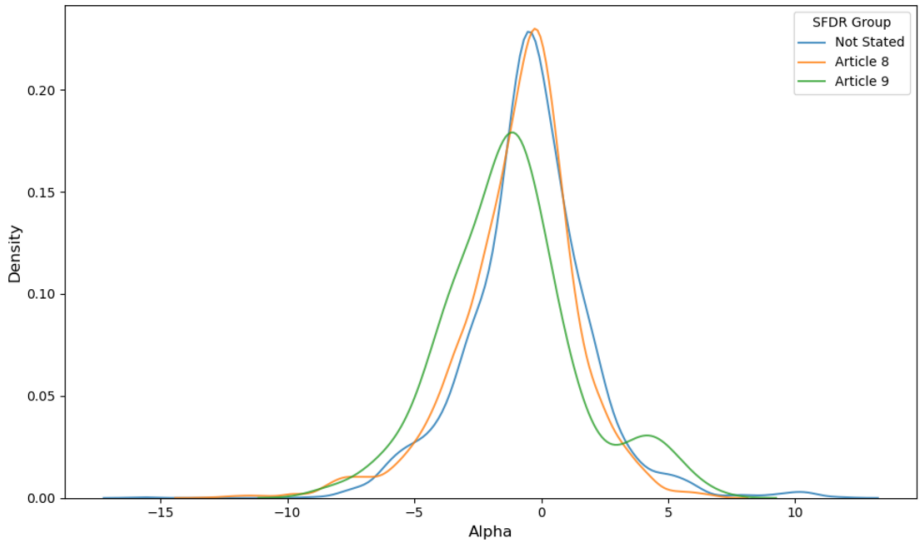


Figure 9: Density Curves of 5-year Alpha Grouped by SFDR classification.

6.3.2 Regression Results

Table 7 presents the results of the panel regression using DID method based on equation 3. We separately consider the two treatment groups Article 8 and Article 9 with the same control group Article 6 (Non-ESG funds), in both the short-term and long-term.

The interaction term (SFDR * Post) for Article 8 funds is statistically significant, and the coefficients for short-term and long-term periods are -0.080 and -0.104, respectively. This finding indicates that the implementation of the SFDR policy negatively affects the overall performance of Article 8 funds in Star Ratings. These negative coefficients further indicate the trade-off between sustainability labels and performance. On the other hand, the interaction term (Post × SFDR) for Art. 9 funds is statistically insignificant for both short and long-term. There is

no significant change in the likelihood of receiving a high Star Rating for Article 9 funds after the SFDR was implemented.

The SFDR coefficient, which measures the baseline difference in Star Ratings before and after the implementation of the SFDR, is positive and statistically significant for Article 8 and Article 9 funds. It shows that the Star Ratings of Article 8 and Article 9 funds tended to be greater than those of Article 6 funds prior to SFDR implementation. Specifically, the positive coefficients imply that funds with sustainability as a goal (Article 9) and those that promote sustainability features (Article 8) were previously recognized as superior performers in terms of Star Ratings compared to Article 6 grey funds.

The post variable captures the common time effect on both treatment groups (Articles 8 and 9) and the control group (Article 6) from the pre-SFDR to the post-SFDR period. Article 8 regression reports a significant positive coefficient in the short-term, while it changes to insignificant in the long run. Similarly, the Post variable in Article 9 regression moves from insignificant in the short-term to significantly negative in the long-term. It indicates that external factors over the short-run period bring the advantage of upgrading the Star Rating grade, while this promoting effect tends to decline and even reverse in the long-term.

	High Star Rating			
	(A) Article 8		(B) Article 9	
	(1) Short term	(2) Long term	(1) Short term	(2) Long term
SFDR * Post	-0.080***	-0.104***	-0.007	0.001
	(-6.691)	(-7.891)	(-0.307)	(0.035)
SFDR (Art. 8 or 9)	0.169***	0.176***	0.124***	0.081***
	(13.455)	(13.715)	(3.805)	(2.627)
Post	0.036***	0.019*	0.006	-0.019**
	(3.544)	(1.664)	(0.802)	(-2.198)
Monthly Return	0.003***	0.002**	0.003***	0.002**
	(2.679)	(2.279)	(2.722)	(2.160)
5Yr Beta	0.220***	0.204***	0.339***	0.351***
	(7.239)	(6.890)	(9.965)	(10.661)
5Yr Volatility	0.004***	0.005***	-0.001	-0.001
	(4.124)	(5.204)	(-0.323)	(-0.780)
5Yr Alpha	0.030***	0.035***	0.036***	0.037***
	(9.312)	(10.715)	(10.847)	(10.969)
Turnover Ratio	0.000***	0.000**	0.000***	0.000*
	(3.569)	(2.263)	(3.330)	(1.969)
Expense Ratio	-0.159***	-0.158***	-0.136***	-0.136***
	(-22.244)	(-23.283)	(-12.665)	(-12.988)
Sortino Ratio	0.100***	0.128***	0.097***	0.123***
	(7.806)	(10.717)	(4.899)	(6.704)
12 Mo Yield	-0.010***	-0.006***	-0.008**	-0.004
	(-4.117)	(-2.602)	(-2.210)	(-1.239)
Morningstar Globe Rating				

2 Globes	0.163***	0.184***	0.126***	0.146***
	(7.484)	(9.509)	(4.309)	(5.283)
3 Globes	0.238***	0.240***	0.179***	0.178***
	(12.003)	(13.509)	(6.985)	(6.729)
4 Globes	0.304***	0.294***	0.231***	0.238***
	(15.555)	(16.628)	(8.634)	(9.308)
5 Globes	0.345***	0.333***	0.230***	0.265***
	(14.519)	(15.715)	(5.974)	(7.420)
Clustered Cov. Estimator	YES	YES	YES	YES
Number of observations	381696	664356	118368	200508
R-Squared	0.490	0.483	0.426	0.425

Table 7. Difference-in-difference regression results on high Star Rating

6.3.3 Multicollinearity Check

As in hypotheses 1 and 2, we check multicollinearity checks using the correlation matrix (Appendix 8) and heatmap (Appendix 9) for independent variables.

We continue to take correlation > 0.7 as the threshold and pick out 5 independent variables that can pass the test but report relatively higher correlation coefficients. We calculate VIF to double-check.

	(A) Article 8		(B) Article 9	
	(1) Short term	(2) Long term	(1) Short term	(2) Long term
SFDR (Art. 8 or 9)	1.031	1.027	1.344	1.335
5Yr Volatility	1.639	1.649	1.495	1.517
Sortino Ratio	1.507	1.522	1.353	1.362
Expense Ratio	1.186	1.181	1.166	1.166
Alpha	1.272	1.265	1.193	1.187

Table 8. VIF Result

We take VIF > 5 as threshold and observe no significant multicollinearity.

7. Discussion

7.1 Discussion on Hypothesis 1

Our results show that implementing the SFDR did not increase the overall fund flows of articles 8 and 9, rejecting Hypothesis 1 (H1). It was evident from our findings that the SFDR policy led to a decrease in capital flow for article 9 funds. This result diverges from those of Scherer and Hasaj (2023), who observed significant capital flows into Article 9 funds after the implementation of the SFDR. They concluded that SFDR labels successfully channel capital flows into greener funds. However, our research focuses on open-end funds, considered primarily active funds, while Scherer and Hasaj (2023) relied on a sample composed of ETFs, mostly passive funds. These management strategy distinctions may significantly affect how capital flows change to SFDR labeling. It implies that the different natures of funds lead to different outcomes regarding capital movements after the SFDR policy.

Another critical factor to consider is the analysis period. In order to capture long-term effects and market adjustments after SFDR's implementation, our analysis looks at a longer horizon, from September 2017 to August 2024. On the other hand, Scherer and Hasaj (2023) focus primarily on the early implementation effects from February 2022 to April 2023, emphasizing recent changes in investment behavior within a shorter time frame. Our research suggests that the time context plays a role in determining the long-term effectiveness of the SFDR in steering capital toward sustainable funds. We show possible challenges in retaining investor interest in sustainability-labeled funds over the long run.

Furthermore, our findings show insignificant changes in capital flows to Article 8 funds over the long-term following the implementation of SFDR. It may reflect investor skepticism toward funds with broad ESG claims. Candelon et al. (2021) found that sustainability labels are applied opportunistically without substantive ESG alignment. Although we do not specifically measure ESG washing as highlighted by Candelon et al. (2021), our findings reflect similar patterns identified in the literature, where sustainability labels lose their ability to attract investor interest.

Our findings suggest that the transparency requirements outlined in the SFDR may not have effectively aided in an increase in capital flows light and deep green. This resonates with

Gantchev et al. (2023), who demonstrate that increased transparency in U.S. mutual funds did not incentivize managers to adjust their portfolios toward more sustainable investments. Transparency may not adequately address investor concerns about ESG alignment or incentivize fund managers to transition their portfolios toward sustainability-focused investments. Therefore, our results raise broader questions about whether transparency-focused regulations need to be paired with stronger enforcement mechanisms or clearer definitions of sustainability to channel capital flows into sustainable investments effectively.

7.2 Discussion on Hypothesis 2

In the short-term, we find no significant change in flows for Article 8 or 9 funds after SFDR implementation, and this is why we reject hypothesis 2. Our findings again deviate from Scherer and Hasaj (2023), further suggesting the importance of timeframe and management strategy in understanding SFDR's impact.

Interestingly, we also observe the same trend as in hypothesis 1, which is that prior to the implementation of SFDR, Article 9 funds exhibited a positive flow trend, attracting higher capital flows in the short-term. One possible explanation is from the performance perspective that Article 9 performed better overall compared to Articles 6 & 8 (see Figure 7). Another explanation is that investors already recognized funds as deep green and favored sustainable investments before regulatory intervention. Similar to the broader trends in Europe, ESG-focused investing gained traction before 2021 (EFAMA, 2021). Previous research also highlights the growing emphasis on ESG consciousness among EU investors (Skadden, 2021). Examining the findings from H1 and H2, the comparison between short-term and long-term results raises questions about the effectiveness of transparency-focused regulations like SFDR. Our findings suggest that simply being transparent is insufficient to attract more capital flow into SFDR-labelled funds.

7.3 Discussion on Hypothesis 3

Our findings showed that Article 8 funds experienced a minor but statistically significant decline in Star Ratings in both the short and long-term. We observed a trade-off between

performance and sustainability characteristics for Article 8. This implies that investors have re-examined the relationship between sustainability and performance after the implementation of SFDR. According to Stark (2023), investors may be conflicted between pursuing financial returns and sustainable objectives. Gantchev et al. (2023) also highlight that poor performance is often associated with sustainability-focused investments. This is not necessarily due to the quality of the underlying stocks but rather because of the strategic changes required to align with sustainability objectives. Therefore, we accept the hypothesis for Article 8 light green funds that post-regulation has created tension between achieving sustainability goals and delivering strong financial returns.

After implementing SFDR for deep green funds, there were no significant changes in Star Rating, which implies that the performance and sustainability balance of Article 9 funds has been preserved. The stability in Star Ratings can likely be traced back to the strict regulations set by the SFDR, which ensure that funds stay in line with sustainability objectives and reduce possible trade-offs. Article 9 funds did not show a significant trade-off, which could imply that investors had already priced in the high sustainability standards of Article 9 funds even before the SFDR was introduced. As a result, after the SFDR came into effect, investors did not observe any significant advancements in the performance of these funds.

8. Conclusions

This study evaluated the impact of the Sustainable Finance Disclosure Regulation (SFDR) on capital flows and performance (measured by Star Ratings) of light green and deep green funds. Our objective was to understand if SFDR successfully guided capital toward sustainable investments and whether there were any trade-offs between sustainability and performance.

Our findings indicated that in the long run, Article 9 funds experienced a relative decrease in capital flow, while Article 8 funds showed no change in flow. In the short-term, the SFDR implementation had no significant change in capital flow for either Article 8 or Article 9 funds. These results suggest that, thus far, the SFDR has not succeeded in increasing sustained capital flows toward sustainability-labeled funds. Interestingly, there was an increase in flow for article 9 originally before SFDR's introduction, while this policy did not amplify this trend. Our findings highlight the challenges of influencing investor behavior through transparency-focused regulations alone. This suggests that simply improving transparency might not be enough to influence investor behavior effectively.

We observed a noticeable decline in performance for Article 8 following SFDR policy, which emphasized the trade-off between performance and sustainability for light green funds over a longer period. On the other hand, deep green funds do not demonstrate such a trade-off, implying that SFDR regulation does not affect deep green funds in the same way as light green. These trends suggest that investors' preferences toward sustainability-labeled funds differ based on the degree of ESG of their classification.

Overall, our analysis reveals that the transparency and classification framework of SFDR has not mobilized capital flows toward sustainable investments over the long run. This study contributes to existing literature on the SFDR's effectiveness. We provide insights into its challenges and limitations in driving capital flows and maintaining investor confidence in sustainability-labeled funds.

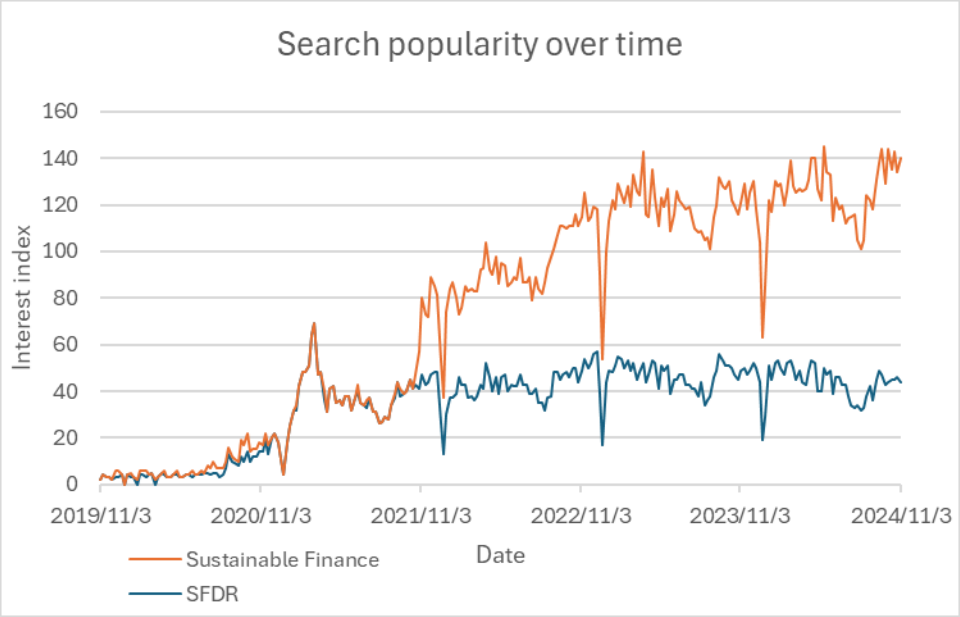
9. Limitations & Future Research Suggestions

Our thesis only focuses on pre- and post-SFDR, yet we do not have a more extended period to investigate whether similar conclusions still hold. We are missing a broader context due to time constraints that might provide additional insights into trends. Future studies that incorporate a longer timeline could strengthen the analysis. Geopolitical risk is also one limitation, such as the Russia and Ukrainian war in February 2022, which occurred in the middle of the timeline chosen for this study. It is also important to acknowledge the impact of significant events like that. There are several exogenous factors to consider, such as economic conditions, market demand for ESG, and regulatory constraints, which can all play a significant role and may be challenging to factor in when evaluating such policy. These aspects are difficult to account for; however, future research can consider this to see if such factors result in different conclusions. Additionally, focusing only on Morningstar data limits our analysis as one source of data may introduce bias because they are often seen as backward-looking ratings. Moreover, Morningstar's Star Ratings are based on historical risk-adjusted returns, which may not be reliable indicators of future performance. As mentioned in this paper earlier, there is a lack of a universal standard for ESG ratings, which remains a challenge.

More research is needed to add to a broader debate about ESG regulations. Other suggestions for future research could be investigating how different regulatory approaches to sustainability disclosure across regions affect global investor behavior, i.e., fund flows. Considering that the SFDR category is reported on a yearly basis for compliance, future research can further study the effect of SFDR based on the time-varying variables. Given the conclusion we reached in this study, it is also interesting for future research to investigate what terminated the effect of Articles 8 and 9.

Appendices

Appendix 1



Appendix 1. Google trends across the whole world show a rise in popularity in terms of sustainable finance and lower popularity in SFDR worldwide, given that SFDR regulation is only enforced in the EU region.

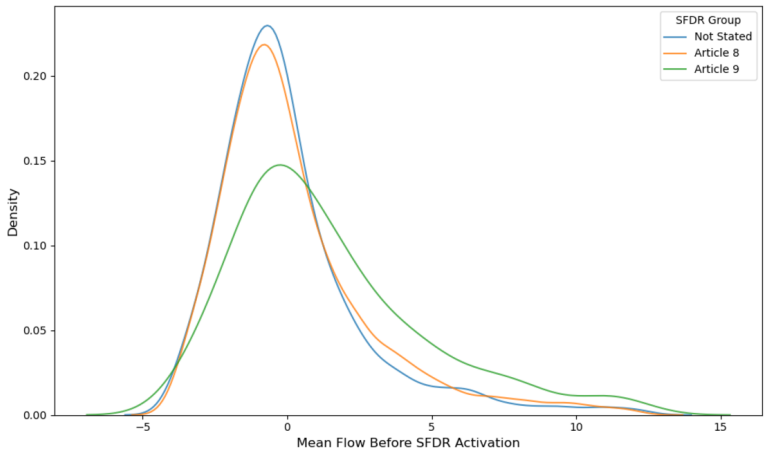
Appendix 2

Entity disclosures	Article 3	Publish on their website information about their policies on the integration of sustainability risks in their investment decision-making process
	Article 4	Publish on their websites whether they do consider or not the adverse impacts generated on sustainability factors and the due diligence policies adopted with respect to those impacts
	Article 5	Publish on their websites information on how remuneration policies are consistent with the integration of sustainability risks
Product level disclosures	Article 6	Provide in pre-contractual disclosures information on how sustainability risks are integrated into investment decisions and the impacts of sustainability risks on the returns of the financial products
	Article 7	Provide in pre-contractual disclosures a clear and reasoned explanation of whether and, if so, how a financial product considers principal adverse impacts on sustainability factors
	Article 8	Provide in pre-contractual disclosures and periodic reports information on how the financial product promotes and respects social or environmental characteristics and the methodology used for measuring social or environmental characteristics
	Article 9	Provide in pre-contractual disclosures and periodic reports information on how the financial product contributes to the achievement of the sustainable objective and how the sustainable goal stands out from a traditional market objective

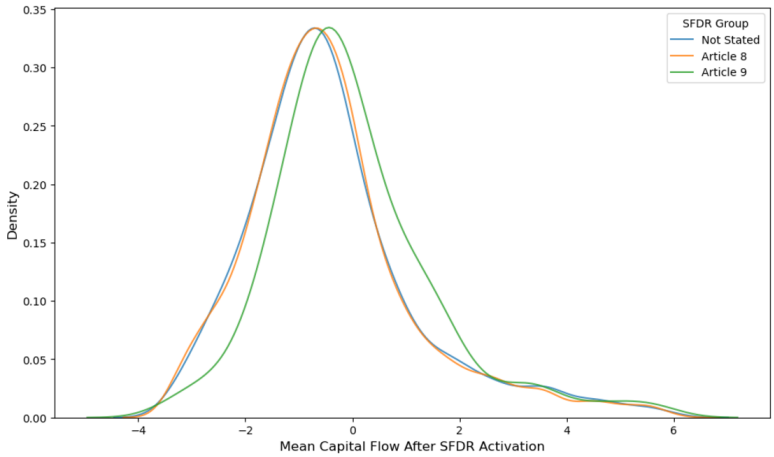
Appendix 2. Summary of Articles in the SFDR Regulation.

Source: EU Sustainable Finance Disclosure Regulation (SFDR) 2019/2088, simplified explanations by the article of Bengo et al. (2022).

Appendix 3

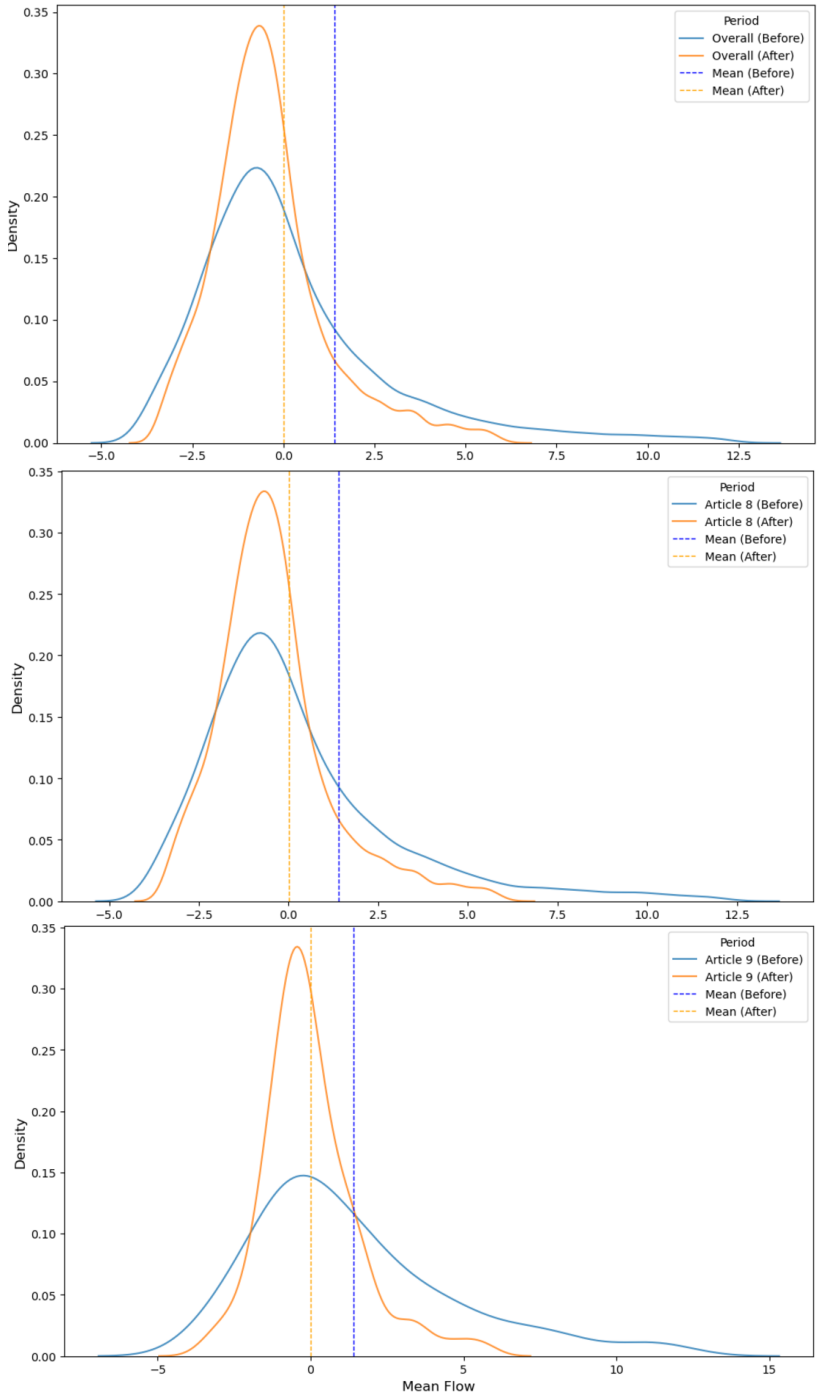


Density Curves of Mean Capital Flow Grouped by SFDR Before SFDR Activation



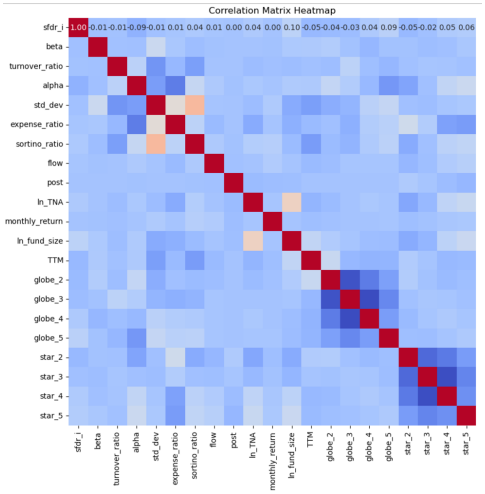
Density Curves of Mean Capital Flow Grouped by SFDR After SFDR Activation

Appendix 4

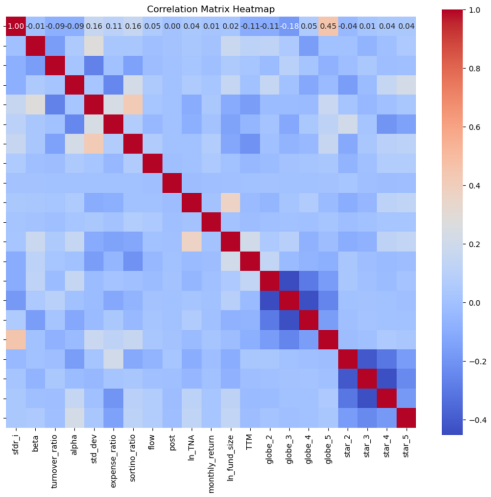


Appendix 4. Density Curves of Mean Flow for Article 6, 8 and 9 Grouped by Period

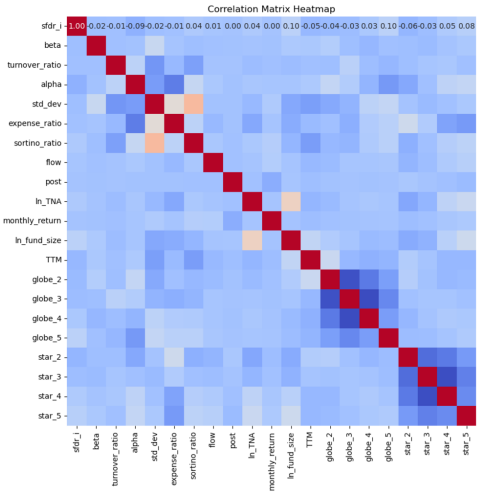
Appendix 5



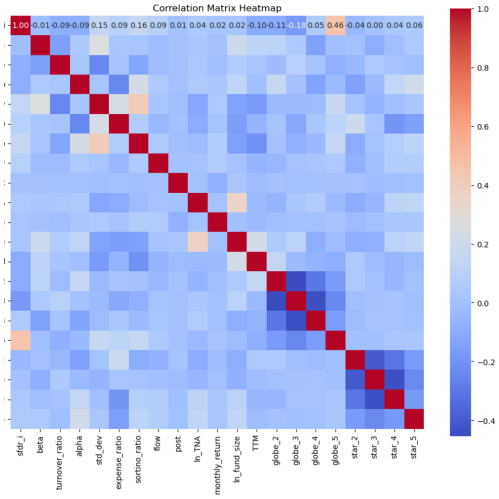
Art.8 Long term



Art.9 Long term



Art.8 Short term



Art.9 Short term

Appendix 5. Correlation Heatmap for regressions in Hypothesis 1 and 2

Appendix 6

	SFDR	5Yr Beta	Turnover Ratio	5Yr Alpha	5Yr Volatility	Expense Ratio	Sortino Ratio	Flow	Post	TNA (ln)	Monthly Return	AUM (ln)	12 Mo Yield	2 Globes	3 Globes	4 Globes	5 Globes	2 Stars	3 Stars	4 Stars	5 Stars
SFDR	1.000	-0.014	-0.007	-0.086	-0.010	0.012	0.036	0.010	0.000	0.038	0.003	0.101	-0.052	-0.044	-0.032	0.038	0.092	-0.052	-0.016	0.049	0.058
5Yr Beta	-0.014	1.000	-0.008	-0.018	0.169	0.021	-0.026	-0.004	0.001	-0.002	-0.004	0.038	0.039	0.058	-0.006	-0.061	-0.007	-0.003	-0.030	-0.015	0.025
Turnover Ratio	-0.007	-0.008	1.000	0.101	-0.211	-0.054	-0.174	0.001	0.000	-0.036	-0.015	-0.030	-0.012	-0.029	0.103	-0.023	-0.063	-0.010	0.014	0.006	-0.011
5Yr Alpha	-0.086	-0.018	0.101	1.000	-0.174	-0.295	0.142	0.040	-0.002	0.031	0.009	0.047	0.041	0.131	0.057	-0.053	-0.198	-0.148	-0.018	0.128	0.164
5Yr Volatility	-0.010	0.169	-0.211	-0.174	1.000	0.295	0.504	0.009	-0.001	-0.036	0.045	-0.118	-0.173	-0.110	-0.075	0.090	0.140	-0.016	-0.029	0.011	0.029
Expense Ratio	0.012	0.021	-0.054	-0.295	0.295	1.000	0.106	-0.044	-0.001	-0.121	0.004	-0.095	-0.045	-0.018	-0.099	0.056	0.088	0.189	0.056	-0.159	-0.185
Sortino Ratio	0.036	-0.026	-0.174	0.142	0.504	0.106	1.000	0.039	-0.005	0.061	0.075	-0.041	-0.183	-0.039	-0.078	0.046	0.096	-0.120	-0.015	0.098	0.122
Flow	0.010	-0.004	0.001	0.040	0.009	-0.044	0.039	1.000	-0.011	0.001	0.052	0.004	-0.046	-0.025	0.011	0.014	0.011	-0.065	-0.023	0.050	0.080
Post	0.000	0.001	0.000	-0.002	-0.001	-0.001	-0.005	-0.011	1.000	-0.038	-0.027	-0.024	-0.001	0.000	0.000	0.000	0.001	0.047	0.011	-0.035	-0.059
TNA (ln)	0.038	-0.002	-0.036	0.031	-0.036	-0.121	0.061	0.001	-0.038	1.000	0.009	0.371	-0.074	-0.037	0.000	0.028	0.013	-0.135	-0.053	0.118	0.157
Monthly Return	0.003	-0.004	-0.015	0.009	0.045	0.004	0.075	0.052	-0.027	0.009	1.000	0.007	-0.022	-0.011	0.001	0.002	0.010	-0.023	-0.005	0.016	0.027
AUM (ln)	0.101	0.038	-0.030	0.047	-0.118	-0.095	-0.041	0.004	-0.024	0.371	0.007	1.000	0.128	0.049	0.012	-0.030	-0.036	-0.118	-0.069	0.102	0.164
12 Mo Yield	-0.052	0.039	-0.012	0.041	-0.173	-0.045	-0.183	-0.046	-0.001	-0.074	-0.022	0.128	1.000	0.157	-0.059	-0.082	-0.074	0.050	0.004	-0.048	-0.043
2 Globes	-0.044	0.058	-0.029	0.131	-0.110	-0.018	-0.039	-0.025	0.000	-0.037	-0.011	0.049	0.157	1.000	-0.439	-0.302	-0.167	0.057	-0.007	-0.046	-0.020
3 Globes	-0.032	-0.006	0.103	0.057	-0.075	-0.099	-0.078	0.011	0.000	0.000	0.001	0.012	-0.059	-0.439	1.000	-0.466	-0.257	-0.009	0.016	0.011	-0.009
4 Globes	0.038	-0.061	-0.023	-0.053	0.090	0.056	0.046	0.014	0.000	0.028	0.002	-0.030	-0.082	-0.302	-0.466	1.000	-0.177	-0.047	0.011	0.039	0.012
5 Globes	0.092	-0.007	-0.063	-0.198	0.140	0.088	0.096	0.011	0.001	0.013	0.010	-0.036	-0.074	-0.167	-0.257	-0.177	1.000	-0.021	-0.025	0.004	0.043
2 Stars	-0.052	-0.003	-0.010	-0.148	-0.016	0.189	-0.120	-0.065	0.047	-0.135	-0.023	-0.118	0.050	0.057	-0.009	-0.047	-0.021	1.000	-0.366	-0.306	-0.180
3 Stars	-0.016	-0.030	0.014	-0.018	-0.029	0.056	-0.015	-0.023	0.011	-0.053	-0.005	-0.069	0.004	-0.007	0.016	0.011	-0.025	-0.366	1.000	-0.460	-0.271
4 Stars	0.049	-0.015	0.006	0.128	0.011	-0.159	0.098	0.050	-0.035	0.118	0.016	0.102	-0.048	-0.046	0.011	0.039	0.004	-0.306	-0.460	1.000	-0.226
5 Stars	0.058	0.025	-0.011	0.164	0.029	-0.185	0.122	0.080	-0.059	0.157	0.027	0.164	-0.043	-0.020	-0.009	0.012	0.043	-0.180	-0.271	-0.226	1.000

Appendix 6.1 Group A

	SFDR	5Yr Beta	Turnover Ratio	5Yr Alpha	5Yr Volatility	Expense Ratio	Sortino Ratio	Flow	Post	TNA (ln)	Monthly Return	AUM (ln)	12 Mo Yield	2 Globes	3 Globes	4 Globes	5 Globes	2 Stars	3 Stars	4 Stars	5 Stars
SFDR	1.000	-0.008	-0.089	-0.093	0.156	0.106	0.158	0.053	0.003	0.041	0.013	0.019	-0.106	-0.107	-0.182	0.054	0.454	-0.040	0.013	0.035	0.037
5Yr Beta	-0.008	1.000	-0.166	0.049	0.284	0.033	0.030	-0.015	0.002	0.029	0.004	0.176	0.114	0.120	0.043	-0.166	0.001	0.000	-0.071	-0.012	0.042
Turnover Ratio	-0.089	-0.166	1.000	0.018	-0.269	0.000	-0.150	-0.023	0.000	0.023	-0.012	0.048	0.022	-0.028	0.096	0.015	-0.084	-0.018	0.035	-0.018	-0.015
5Yr Alpha	-0.093	0.049	0.018	1.000	0.022	-0.250	0.222	0.049	0.001	0.054	0.019	0.151	-0.004	0.153	-0.001	-0.122	-0.034	-0.164	-0.029	0.152	0.219
5Yr Volatility	0.156	0.284	-0.269	0.022	1.000	0.238	0.416	0.021	-0.004	-0.103	0.036	-0.108	-0.167	-0.029	-0.032	-0.033	0.171	0.014	-0.046	-0.007	0.031
Expense Ratio	0.106	0.033	0.000	-0.250	0.238	1.000	0.068	-0.047	-0.004	-0.088	0.002	-0.144	-0.059	0.009	-0.120	0.039	0.119	0.210	0.016	-0.203	-0.151
Sortino Ratio	0.158	0.030	-0.150	0.222	0.416	0.068	1.000	0.063	-0.004	-0.001	0.068	-0.128	-0.211	-0.005	-0.073	-0.043	0.155	-0.116	0.024	0.098	0.111
Flow	0.053	-0.015	-0.023	0.049	0.021	-0.047	0.063	1.000	-0.015	-0.001	0.045	0.000	-0.049	-0.028	0.002	0.015	0.031	-0.069	-0.006	0.067	0.068
Post	0.003	0.002	0.000	0.001	-0.004	-0.004	-0.004	-0.015	1.000	-0.024	-0.015	-0.007	0.001	0.002	0.000	-0.003	0.004	0.023	-0.012	-0.027	-0.018
TNA (ln)	0.041	0.029	0.023	0.054	-0.103	-0.088	-0.001	-0.001	-0.024	1.000	0.006	0.365	-0.037	-0.058	0.017	0.061	-0.038	-0.097	-0.050	0.113	0.129
Monthly Return	0.013	0.004	-0.012	0.019	0.036	0.002	0.068	0.045	-0.015	0.006	1.000	0.003	-0.024	-0.005	0.000	-0.006	0.013	-0.020	-0.001	0.020	0.021
AUM (ln)	0.019	0.176	0.048	0.151	-0.108	-0.144	-0.128	0.000	-0.007	0.365	0.003	1.000	0.206	0.043	0.087	-0.076	-0.026	-0.098	-0.075	0.117	0.139
12 Mo Yield	-0.106	0.114	0.022	-0.004	-0.167	-0.059	-0.211	-0.049	0.001	-0.037	-0.024	0.206	1.000	0.138	-0.033	-0.069	-0.086	0.027	-0.017	-0.034	-0.022
2 Globes	-0.107	0.120	-0.028	0.153	-0.029	0.009	-0.005	-0.028	0.002	-0.058	-0.005	0.043	0.138	1.000	-0.453	-0.298	-0.174	0.033	-0.006	-0.029	0.012
3 Globes	-0.182	0.043	0.096	-0.001	-0.032	-0.120	-0.073	0.002	0.000	0.017	0.000	0.087	-0.033	-0.453	1.000	-0.437	-0.256	-0.002	0.005	-0.001	-0.011
4 Globes	0.054	-0.166	0.015	-0.122	-0.033	0.039	-0.043	0.015	-0.003	0.061	-0.006	-0.076	-0.069	-0.298	-0.437	1.000	-0.168	-0.012	0.008	-0.001	-0.002
5 Globes	0.454	0.001	-0.084	-0.034	0.171	0.119	0.155	0.031	0.004	-0.038	0.013	-0.026	-0.086	-0.174	-0.256	-0.168	1.000	-0.024	-0.008	0.043	0.027
2 Stars	-0.040	0.000	-0.018	-0.164	0.014	0.210	-0.116	-0.069	0.023	-0.097	-0.020	-0.098	0.027	0.033	-0.002	-0.012	-0.024	1.000	-0.411	-0.308	-0.170
3 Stars	0.013	-0.071	0.035	-0.029	-0.046	0.016	0.024	-0.006	-0.012	-0.050	-0.001	-0.075	-0.017	-0.006	0.005	0.008	-0.008	-0.411	1.000	-0.438	-0.242
4 Stars	0.035	-0.012	-0.018	0.152	-0.007	-0.203	0.098	0.067	-0.027	0.113	0.020	0.117	-0.034	-0.029	-0.001	-0.001	0.043	-0.308	-0.438	1.000	-0.181
5 Stars	0.037	0.042	-0.015	0.219	0.031	-0.151	0.111	0.068	-0.018	0.129	0.021	0.139	-0.022	0.012	-0.011	-0.002	0.027	-0.170	-0.242	-0.181	1.000

Appendix 6.2 Group B

Appendix 6. Correlation Matrices for Regression in Hypothesis 1

Appendix 7

	SFDR	5Yr Beta	Turnover Ratio	5Yr Alpha	5Yr Volatility	Expense Ratio	Sortino Ratio	Flow	Post	TNA (ln)	Monthly Return	AUM (ln)	12 Mo Yield	2 Globes	3 Globes	4 Globes	5 Globes	2 Stars	3 Stars	4 Stars	5 Stars
SFDR	1.000	-0.022	-0.012	-0.086	-0.019	-0.009	0.041	0.014	0.002	0.044	0.002	0.103	-0.053	-0.040	-0.029	0.031	0.098	-0.064	-0.026	0.051	0.083
5Yr Beta	-0.022	1.000	-0.015	-0.005	0.159	0.011	-0.020	-0.009	-0.001	0.005	-0.004	0.038	0.034	0.068	-0.018	-0.057	-0.011	-0.018	-0.035	0.002	0.033
Turnover Ratio	-0.012	-0.015	1.000	0.104	-0.200	-0.045	-0.161	0.001	0.001	-0.029	-0.013	-0.030	-0.011	-0.020	0.093	-0.026	-0.062	-0.022	0.014	0.026	-0.015
5Yr Alpha	-0.086	-0.005	0.104	1.000	-0.177	-0.297	0.146	0.034	-0.002	0.019	0.014	0.014	0.038	0.135	0.060	-0.071	-0.191	-0.130	-0.014	0.111	0.134
5Yr Volatility	-0.019	0.159	-0.200	-0.177	1.000	0.297	0.500	-0.003	-0.004	-0.049	0.048	-0.127	-0.169	-0.122	-0.078	0.104	0.132	0.002	-0.041	-0.006	0.035
Expense Ratio	-0.009	0.011	-0.045	-0.297	0.297	1.000	0.107	-0.046	-0.002	-0.129	0.009	-0.111	-0.044	-0.016	-0.101	0.053	0.089	0.185	0.054	-0.149	-0.183
Sortino Ratio	0.041	-0.020	-0.161	0.146	0.500	0.107	1.000	0.026	-0.006	0.033	0.072	-0.064	-0.174	-0.052	-0.069	0.051	0.091	-0.096	-0.015	0.073	0.106
Flow	0.014	-0.009	0.001	0.034	-0.003	-0.046	0.026	1.000	-0.007	0.009	0.066	0.008	-0.049	-0.037	0.015	0.016	0.019	-0.071	-0.023	0.052	0.084
Post	0.002	-0.001	0.001	-0.002	-0.004	-0.002	-0.006	-0.007	1.000	-0.006	-0.107	0.013	-0.019	0.000	0.001	-0.001	0.001	0.023	0.002	-0.012	-0.034
TNA (ln)	0.044	0.005	-0.029	0.019	-0.049	-0.129	0.033	0.009	-0.006	1.000	0.011	0.372	-0.067	-0.043	0.007	0.026	0.015	-0.134	-0.065	0.109	0.165
Monthly Return	0.002	-0.004	-0.013	0.014	0.048	0.009	0.072	0.066	-0.107	0.011	1.000	0.005	-0.027	-0.010	0.000	0.002	0.010	-0.028	-0.007	0.018	0.036
AUM (ln)	0.103	0.038	-0.030	0.014	-0.127	-0.111	-0.064	0.008	0.013	0.372	0.005	1.000	0.128	0.054	0.016	-0.040	-0.032	-0.115	-0.084	0.088	0.180
12 Mo Yield	-0.053	0.034	-0.011	0.038	-0.169	-0.044	-0.174	-0.049	-0.019	-0.067	-0.027	0.128	1.000	0.164	-0.055	-0.091	-0.073	0.058	0.010	-0.053	-0.054
2 Globes	-0.040	0.068	-0.020	0.135	-0.122	-0.016	-0.052	-0.037	0.000	-0.043	-0.010	0.054	0.164	1.000	-0.443	-0.304	-0.168	0.073	0.000	-0.054	-0.044
3 Globes	-0.029	-0.018	0.093	0.060	-0.078	-0.101	-0.069	0.015	0.001	0.007	0.000	0.016	-0.055	-0.443	1.000	-0.462	-0.255	-0.008	0.013	0.016	-0.007
4 Globes	0.031	-0.057	-0.026	-0.071	0.104	0.053	0.051	0.016	-0.001	0.026	0.002	-0.040	-0.091	-0.304	-0.462	1.000	-0.175	-0.060	0.006	0.041	0.030
5 Globes	0.098	-0.011	-0.062	-0.191	0.132	0.089	0.091	0.019	0.001	0.015	0.010	-0.032	-0.073	-0.168	-0.255	-0.175	1.000	-0.028	-0.026	0.010	0.049
2 Stars	-0.064	-0.018	-0.022	-0.130	0.002	0.185	-0.096	-0.071	0.023	-0.134	-0.028	-0.115	0.058	0.073	-0.008	-0.060	-0.028	1.000	-0.351	-0.303	-0.188
3 Stars	-0.026	-0.035	0.014	-0.014	-0.041	0.054	-0.015	-0.023	0.002	-0.065	-0.007	-0.084	0.010	0.000	0.013	0.006	-0.026	-0.351	1.000	-0.453	-0.281
4 Stars	0.051	0.002	0.026	0.111	-0.006	-0.149	0.073	0.052	-0.012	0.109	0.018	0.088	-0.053	-0.054	0.016	0.041	0.010	-0.303	-0.453	1.000	-0.242
5 Stars	0.08294	0.033223	-0.01498	0.134059	0.034536	-0.18304	0.106397	0.084331	-0.03447	0.16519	0.035915	0.180189	-0.05363	-0.04401	-0.00712	0.030439	0.049237	-0.18777	-0.28056	-0.24248	1

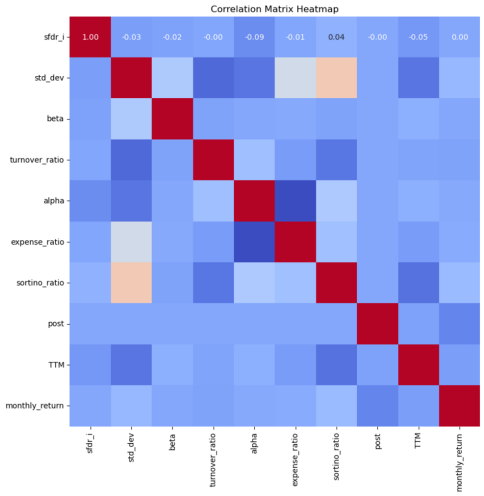
Appendix 7.1 Group A

	SFDR	5Yr Beta	Turnover Ratio	5Yr Alpha	5Yr Volatility	Expense Ratio	Sortino Ratio	Flow	Post	TNA (ln)	Monthly Return	AUM (ln)	12 Mo Yield	2 Globes	3 Globes	4 Globes	5 Globes	2 Stars	3 Stars	4 Stars	5 Stars
SFDR	1.000	-0.014	-0.091	-0.092	0.147	0.093	0.156	0.086	0.005	0.043	0.021	0.021	-0.105	-0.107	-0.179	0.053	0.458	-0.042	0.003	0.040	0.057
5Yr Beta	-0.014	1.000	-0.154	0.042	0.273	0.031	0.023	-0.025	0.002	0.024	0.003	0.186	0.119	0.110	0.043	-0.148	-0.006	0.001	-0.085	-0.012	0.046
Turnover Ratio	-0.091	-0.154	1.000	0.032	-0.247	0.017	-0.132	-0.024	0.000	0.039	-0.012	0.058	0.018	-0.026	0.088	0.013	-0.082	-0.039	0.046	0.009	-0.013
5Yr Alpha	-0.092	0.042	0.032	1.000	0.022	-0.245	0.227	0.046	0.000	0.050	0.024	0.131	-0.008	0.154	0.004	-0.138	-0.037	-0.149	-0.037	0.140	0.208
5Yr Volatility	0.147	0.273	-0.247	0.022	1.000	0.237	0.410	0.022	-0.007	-0.124	0.044	-0.140	-0.173	-0.037	-0.029	-0.026	0.162	0.010	-0.058	-0.010	0.033
Expense Ratio	0.093	0.031	0.017	-0.245	0.237	1.000	0.065	-0.044	-0.004	-0.107	0.007	-0.162	-0.062	0.015	-0.116	0.030	0.110	0.193	0.019	-0.197	-0.154
Sortino Ratio	0.156	0.023	-0.132	0.227	0.410	0.065	1.000	0.053	-0.005	-0.023	0.072	-0.151	-0.205	0.002	-0.082	-0.038	0.152	-0.104	0.012	0.078	0.109
Flow	0.086	-0.025	-0.024	0.046	0.022	-0.044	0.053	1.000	0.003	0.012	0.059	0.007	-0.058	-0.044	0.007	0.019	0.043	-0.078	-0.007	0.074	0.073
Post	0.005	0.002	0.000	0.000	-0.007	-0.004	-0.005	0.003	1.000	0.007	-0.081	0.025	-0.022	0.002	0.000	-0.004	0.006	0.010	-0.019	-0.007	0.000
TNA (ln)	0.043	0.024	0.039	0.050	-0.124	-0.107	-0.023	0.012	0.007	1.000	0.008	0.366	-0.031	-0.060	0.024	0.058	-0.036	-0.098	-0.055	0.116	0.129
Monthly Return	0.021	0.003	-0.012	0.024	0.044	0.007	0.072	0.059	-0.081	0.008	1.000	0.000	-0.032	-0.006	-0.005	-0.002	0.016	-0.024	-0.001	0.026	0.024
AUM (ln)	0.021	0.186	0.058	0.131	-0.140	-0.162	-0.151	0.007	0.025	0.366	0.000	1.000	0.215	0.043	0.106	-0.086	-0.026	-0.088	-0.077	0.106	0.131
12 Mo Yield	-0.105	0.119	0.018	-0.008	-0.173	-0.062	-0.205	-0.058	-0.022	-0.031	-0.032	0.215	1.000	0.146	-0.038	-0.069	-0.088	0.045	-0.019	-0.046	-0.025
2 Globes	-0.107	0.110	-0.026	0.154	-0.037	0.015	0.002	-0.044	0.002	-0.060	-0.006	0.043	0.146	1.000	-0.453	-0.303	-0.171	0.050	-0.004	-0.045	0.006
3 Globes	-0.179	0.043	0.088	0.004	-0.029	-0.116	-0.082	0.007	0.000	0.024	-0.005	0.106	-0.038	-0.453	1.000	-0.440	-0.249	-0.015	0.004	0.017	-0.010
4 Globes	0.053	-0.148	0.013	-0.138	-0.026	0.030	-0.038	0.019	-0.004	0.058	-0.002	-0.086	-0.069	-0.303	-0.440	1.000	-0.166	-0.025	0.009	0.012	-0.001
5 Globes	0.458	-0.006	-0.082	-0.037	0.162	0.110	0.152	0.043	0.006	-0.036	0.016	-0.026	-0.088	-0.171	-0.249	-0.166	1.000	-0.010	-0.009	0.032	0.028
2 Stars	-0.042	0.001	-0.039	-0.149	0.010	0.193	-0.104	-0.078	0.010	-0.098	-0.024	-0.088	0.045	0.050	-0.015	-0.025	-0.010	1.000	-0.407	-0.311	-0.170
3 Stars	0.003138	-0.0853	0.04571	-0.03677	-0.05753	0.018734	0.011764	-0.00724	-0.0187	-0.05523	-0.00137	-0.07702	-0.01924	-0.00382	0.004101	0.008548	-0.00905	-0.40737	1	-0.43733	-0.23979
4 Stars	0.040	-0.012	0.009	0.140	-0.010	-0.197	0.078	0.074	-0.007	0.116	0.026	0.106	-0.046	-0.045	0.017	0.012	0.032	-0.311	-0.437	1.000	-0.183
5 Stars	0.057	0.046	-0.013	0.208	0.033	-0.154	0.109	0.073	0.000	0.129	0.024	0.131	-0.025	0.006	-0.010	-0.001	0.028	-0.170	-0.240	-0.183	1.000

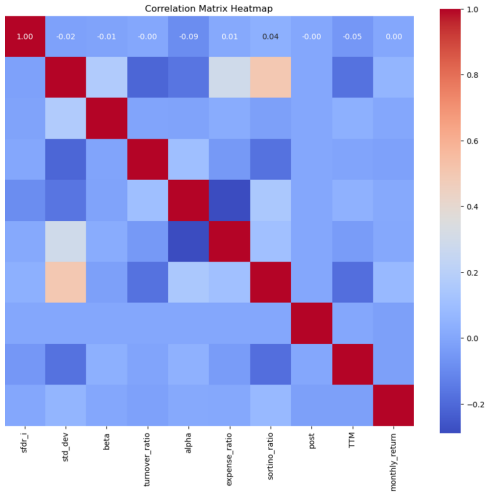
Appendix 7.2 Group B

Appendix 7. Correlation Matrices for Regression in Hypothesis 2

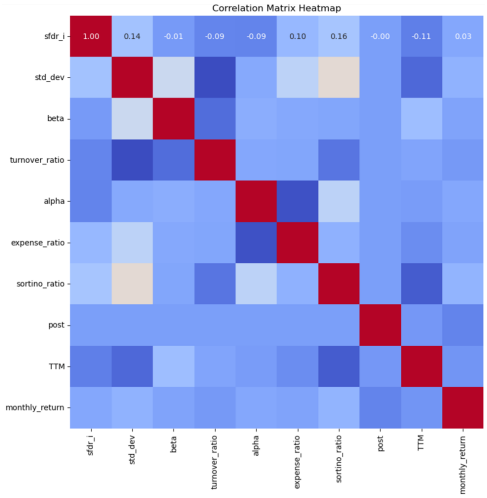
Appendix 8: Correlation Heatmap for regressions in Hypothesis 3



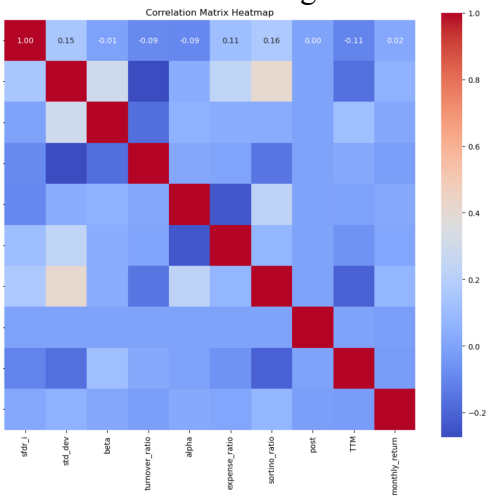
Art.8 Short



Art.8 Long



Art.9 Short



Art.9 Long

Appendix 8. Correlation Heatmap for regressions in Hypothesis 3

Appendix 9: Correlation Matrices for Regression in Hypothesis 3

	SFDR	5Yr Volatility	5Yr Beta	Turnover Ratio	5Yr Alpha	Expense Ratio	Sortino Ratio	Post	12 Mo Yield	Monthly Return
SFDR	1.000	-0.018	-0.013	-0.001	-0.090	0.012	0.037	0.000	-0.052	0.002
5Yr	-0.018	1.000	0.165	-0.212	-0.165	0.294	0.500	0.000	-0.173	0.057
5Yr Beta	-0.013	0.165	1.000	-0.009	-0.014	0.019	-0.022	0.000	0.037	-0.001
Turnover	-0.001	-0.212	-0.009	1.000	0.099	-0.052	-0.173	0.000	-0.011	-0.017
5Yr Alpha	-0.090	-0.165	-0.014	0.099	1.000	-0.289	0.145	0.000	0.039	0.009
Expense	0.012	0.294	0.019	-0.052	-0.289	1.000	0.107	0.000	-0.041	0.008
Sortino	0.037	0.500	-0.022	-0.173	0.145	0.107	1.000	0.000	-0.183	0.078
Post	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	-0.002	-0.027
12 Mo	-0.052	-0.173	0.037	-0.011	0.039	-0.041	-0.183	-0.002	1.000	-0.025
Monthly	0.002	0.057	-0.001	-0.017	0.009	0.008	0.078	-0.027	-0.025	1.000

Appendix 9.1.1 Group A – Long Term

	SFDR	5Yr Volatility	5Yr Beta	Turnover Ratio	5Yr Alpha	Expense Ratio	Sortino Ratio	Post	12 Mo Yield	Monthly Return
SFDR	1.000	-0.028	-0.021	-0.005	-0.089	-0.008	0.040	0.000	-0.054	0.000
5Yr	-0.028	1.000	0.156	-0.201	-0.166	0.295	0.495	0.000	-0.169	0.070
5Yr Beta	-0.021	0.156	1.000	-0.016	0.000	0.008	-0.016	0.000	0.032	0.001
Turnover	-0.005	-0.201	-0.016	1.000	0.102	-0.042	-0.160	0.000	-0.010	-0.016
5Yr Alpha	-0.089	-0.166	0.000	0.102	1.000	-0.290	0.148	0.000	0.036	0.011
Expense	-0.008	0.295	0.008	-0.042	-0.290	1.000	0.108	0.000	-0.042	0.015
Sortino	0.040	0.495	-0.016	-0.160	0.148	0.108	1.000	0.000	-0.175	0.079
Post	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	-0.020	-0.117
12 Mo	-0.054	-0.169	0.032	-0.010	0.036	-0.042	-0.175	-0.020	1.000	-0.031
Monthly	0.000	0.070	0.001	-0.016	0.011	0.015	0.079	-0.117	-0.031	1.000

Appendix 9.1.2 Group A – Short Term

Appendix 9. Correlation Matrices for Regression in Hypothesis 3

	SFDR	5Yr Volatility	5Yr Beta	Turnover Ratio	5Yr Alpha	Expense Ratio	Sortino Ratio	Post	12 Mo Yield	Monthly Return
SFDR	1.000	0.150	-0.008	-0.086	-0.092	0.109	0.160	0.000	-0.106	0.019
5Yr	0.150	1.000	0.297	-0.273	0.037	0.236	0.410	0.000	-0.169	0.055
5Yr Beta	-0.008	0.297	1.000	-0.171	0.058	0.036	0.031	0.000	0.114	0.011
Turnover	-0.086	-0.273	-0.171	1.000	0.014	0.004	-0.149	0.000	0.023	-0.018
5Yr Alpha	-0.092	0.037	0.058	0.014	1.000	-0.239	0.228	0.000	-0.009	0.025
Expense	0.109	0.236	0.036	0.004	-0.239	1.000	0.071	0.000	-0.055	0.006
Sortino	0.160	0.410	0.031	-0.149	0.228	0.071	1.000	0.000	-0.213	0.071
Post	8.48E-18	1.41E-17	1.02E-16	3.92E-17	-3.5E-17	-9.4E-17	1.46E-17	1	-0.00027	-0.01532
12 Mo	-0.106	-0.169	0.114	0.023	-0.009	-0.055	-0.213	0.000	1.000	-0.027
Monthly	0.019	0.055	0.011	-0.018	0.025	0.006	0.071	-0.015	-0.027	1.000

Appendix 9.2.1 Group B – Long Term

	SFDR	5Yr Volatility	5Yr Beta	Turnover Ratio	5Yr Alpha	Expense Ratio	Sortino Ratio	Post	12 Mo Yield	Monthly Return
SFDR	1.000	0.143	-0.014	-0.086	-0.089	0.097	0.157	0.000	-0.105	0.029
5Yr	0.143	1.000	0.286	-0.254	0.037	0.234	0.403	0.000	-0.175	0.073
5Yr Beta	-0.014	0.286	1.000	-0.160	0.052	0.031	0.022	0.000	0.119	0.013
Turnover	-0.08645	-0.25355	-0.16036	1	0.026451	0.022149	-0.13327	-1.5E-17	0.020055	-0.02017
5Yr Alpha	-0.089	0.037	0.052	0.026	1.000	-0.236	0.232	0.000	-0.012	0.029
Expense	0.097	0.234	0.031	0.022	-0.236	1.000	0.068	0.000	-0.059	0.014
Sortino	0.157	0.403	0.022	-0.133	0.232	0.068	1.000	0.000	-0.209	0.078
Post	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	-0.025	-0.092
12 Mo	-0.105	-0.175	0.119	0.020	-0.012	-0.059	-0.209	-0.025	1.000	-0.037
Monthly	0.029	0.073	0.013	-0.020	0.029	0.014	0.078	-0.092	-0.037	1.000

Appendix 9.2.2 Group B – Short Term

Appendix 9 (Cont.). Correlation Matrices for Regression in Hypothesis 3

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AI disclosure

Thesis title: *Sustainability vs. Performance: Impact of SFDR on Mutual Fund Flows and Performance in the European Union*

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In our thesis, ChatGPT assists us with the following aspects:

- Organize the reference format and style. We provide the citing sources and request ChatGPT to generate a standardized Harvard reference style.
- Fix and improve code. We conduct our analyses in Python. We request ChatGPT to debug, comment and improve our code. In some cases, we tell ChatGPT our analysis design and request ChatGPT to generate the example code. Then we customize and adjust based on our data set and expectations, and use them as a part of our code.
- Generate the result tables. We utilize the Linearmodels package to conduct panel regression analysis for Article 8 and Article 9 funds separately and compare their results. ChatGPT assists in combining the result summaries provided by us into result tables. After double-checking we include those tables in our result.

At the same time, we notice the following risks using AI, and take measures to reduce these risks:

- ChatGPT can only provide general code examples, which may deviate from the reality of our dataset. Therefore, we adjust the code manually and run it repeatedly to ensure accuracy and reliability.
- ChatGPT focuses more on typos and has limited ability to handle advanced errors, such as logical errors and incorrect references. Therefore, if ChatGPT cannot debug within two attempts, we will review and fix the code in person.

- Repeated iterations with ChatGPT lead to decreasing accuracy of its output over time. For example, when generating the result table, ChatGPT sometimes outputs the wrong number, especially in the later rows. Therefore, we always double-check before we use these outputs in our thesis.

In the process of writing the code, we gain insights from ChatGPT in conducting analysis. It can provide common error examples when coding our regression model, which guides us to pay more attention to some parts and helps us debug quickly.