SUSTAINABILITY IN ACTIVE MANAGEMENT

SHORT-TERM IMPLICATIONS OF THE SUSTAINABLE FINANCE DISCLOSURE REGULATION

JOHANNA BURHOLM

DANIEL LUNDMARK

Bachelor Thesis

Stockholm School of Economics

2024

Sustainability in Active Management: Short-term Implications of the Sustainable Finance Disclosure Regulation

Abstract:

This paper provides a comparative analysis of the short-term implications on active management of equity mutual funds following the implementation of the European Union's Sustainable Finance Disclosure Regulation (SFDR). We analyze how the short-term development in investor demand, fund size growth, performance, and managerial ability to generate value relate to the relative degree of sustainability objectives for each fund classification under the SFDR. We find that increases in investor demand and fund size growth are associated with higher sustainability-related objectives, along with implications of short-term effects of diminishing returns to scale for the relatively more sustainable funds. Following the SFDR implementation, we do not find that a higher degree of sustainability-related investment constraints has accentuated the effect of decreasing returns to scale in the short-term development. Our findings suggest that the average fund manager of the fund classification with the highest degree of sustainability objective has been the most skilled in navigating the implementation of the SFDR as this classification exhibits superior short-term development in the value extracted from the market.

Keywords:

Active management, Mutual funds, Alpha, Managerial skill, Sustainable finance

Authors:

Johanna Burholm (25350)
Daniel Lundmark (24901)

Tutor:

Mehran Ebrahimian, Assistant Professor, Department of Finance

Examiner:

Adrien d'Avernas, Assistant Professor, Department of Finance

Acknowledgements:

We want to extend our gratitude to Mehran Ebrahimian for his valuable guidance and advice during the research process.

Bachelor Thesis
Bachelor Program in Business and Economics
Stockholm School of Economics
© Johanna Burholm and Daniel Lundmark, 2024

1 Introduction

The increase in environmental consciousness in recent years has prompted a shift in investment behavior and criteria, raising demands on transparency and comparability in ESG-related reporting. As a response, the European Union (EU) passed the Sustainable Finance Disclosure Regulation (SFDR) the 27th of November 2019, which came into application on the 10th of March 2021 (European Commission, n.d.). Under SFDR, financial market participants domiciled in the EU or having products marketed in the EU must self-categorize their products under different articles of the regulation depending on their respective sustainability objectives. Products without a sustainability objective classify as Article 6, while Article 9 references products with sustainability as the primary investment objective. Article 8 products lie in between these two classifications, as they promote and consider sustainability while not having it as their primary investment objective. The sustainability-related disclosure requirements for a product differs between the classifications, where the requirements are the lowest for an Article 6 product and the highest for an Article 9 product (The European Parliament and the Council of the European Union, 2019).

The SFDR transparency framework aims to support informed investor decision making through facilitating and promoting sustainable investment practices, and ultimately assure that more capital is invested in sustainable assets. In turn, this raises the question of whether investors have in fact responded by shifting demand and allocated capital to the relatively more sustainable fund classifications. We are aiming to contribute to the understanding of the short-term impact of this regulation through investigating the development in mutual fund flows and growth in fund size for actively managed equity mutual funds under the respective SFDR classifications. Moreover, we are also interested in understanding if the impact of the implementation of the SFDR has been significantly different for the respective classifications. Thus, our first research question reads as follows:

> *What are the short run implications on investor demand and consequent mutual fund growth for the respective classifications, and has the development differed among classifications, following the implementation of the SFDR?*

Given the expected substantial inflow of capital for the relatively more sustainable fund classifications, we want to investigate if the managerial ability to generate value deteriorates in the short run amidst the implementation of the SFDR. We expect the performance and managerial ability to generate value for Article 9 funds to deteriorate for two reasons. Firstly, previous research has found decreasing returns to scale for actively managed mutual funds (see, for example, Berk & Green (2004), Berk & van Binsbergen (2015) and Pástor, Stambaugh & Taylor (2015)). Secondly, by categorizing as an SFDR Article 9 fund, fund managers self-impose constraints by committing to only sustainable investments, resulting in a smaller set of available investment alternatives relative to the other fund classifications. Consequently, our second research question reads as follows:

> *What are the short run implications on performance and managerial ability to generate value for the respective classifications, and has the development differed among classifications, following the implementation of the SFDR?*

To examine the short run implications of the SFDR implementation, we compare the period from the passing of the regulation (November 27th, 2019) until its implementation (March 10th, 2021) to the subsequent period following the implementation. We investigate the development in mutual fund flows between the two periods and the corresponding development in fund size

for the respective classifications. We follow the methodology proposed by Berk and van Binsbergen (2015) for measuring skill and performance in active mutual fund management. As such, value added, defined as the product of benchmark-adjusted gross excess return and lagged fund size, is used to measure managerial skill and performance is measured using gross and net alpha. To examine the short-term development within classifications following the SFDR implementation, we conduct paired sample t-tests. To further analyze the implications of the SFDR, we construct difference-in-differences models to test if the short-term intra-classification development has been significantly different across classifications. We detail the analysis on the development in value added following the implementation of the SFDR through investigating the explanatory power of cross-sectional variation in gross alpha.

We find substantial capital inflows to the fund classifications with sustainable objectives during the period surrounding the SFDR implementation, reflecting increased investor demand for sustainable assets. However, there were no substantial capital outflows for non-sustainable funds, implying that there has not been a short run shift in investor demand amidst the implementation of classifications. Rather, it is predominantly new capital on the market that has been allocated to sustainable investments. Moreover, we find that a higher degree of sustainability commitment relates to a significantly larger growth in fund size, which is primarily driven by the substantial capital inflows for the relatively more sustainable classifications. This indicates that the short-term capital allocation trends align with the intention behind introducing the SFDR.

For the relatively more sustainable fund classifications, we find significant deterioration in the performance measures in the period following the implementation of the classifications. Along with the significantly larger increase in fund size for these classifications, this deterioration implies decreasing returns to scale. However, contrary to our expectations, we do not find that the higher degree of self-imposed sustainability-related investment constraints for Article 9 funds relative to Article 8 funds has resulted in a significantly larger effect of decreasing returns to scale. The short-term development in value added also contrasts with our expectations, as the classification with the highest self-imposed investment constraints, Article 9, was the only fund category that managed to not significantly decrease the average value extracted from the market. This suggests that the significant deterioration in benchmark-adjusted excess return was offset by the substantial increase in fund size driven by increased investor demand for sustainable funds. Lastly, we find that the explanatory power of cross-sectional differences in gross alpha of cross-sectional variation in value added is consistently small across both subperiods and classifications. This implies that cross-sectional differences in fund size is the primary driver of cross-sectional differences in value added. We also find high cross-sectional variation in fund size development following the SFDR implementation relative to the variation in gross alpha, holding true for all classifications. This finding argues in favor of using value added, as opposed to conventional alpha measures, to measure managerial skill as proposed by Berk and van Binsbergen (2015).

The remainder of our paper proceeds as follows. In section 2, we discuss related literature and section 3 provides a background to the theory underlying our empirical methodology. Section 4 details the data used in the analysis and in section 5 we specify the methodology. In section 6, we present and interpret our empirical results and section 7 provides concluding remarks.

2 Related Literature

Our paper relates and contributes to the large body of research on skill in active mutual fund management (see, e.g., Carhart (1997), Berk & Green (2004), Pástor, Stambaugh & Taylor (2015) and Berk & van Binsbergen (2015)). We add to this field by studying how the implementation of a market-wide regulation, requiring mutual fund managers to self-impose varying degrees of sustainability-related investment constraints, relates to the managerial ability to generate value. More specifically, we are contributing to this literature through examining if the short run implications of this regulation on fund size growth and performance have resulted in a different impact on the managerial ability to generate value among the fund classifications with varying degrees of self-imposed investment constraints. As such, in contrast with previous literature on the topic that predominantly investigate the existence and persistence of managerial skill, we study the implications of a market-wide regulation on active fund management.

In addition to providing further nuance to the literature on active fund management, our paper also relates to literature on investor preferences and demand for green assets (see, for example, Riedl & Smeets (2017), Hartzmark & Sussman (2019), Pástor, Stambaugh & Taylor (2022) and Anderson & Robinson (2022)). Our study contributes to this strand of literature by examining how investor demand for sustainability objectives in mutual funds is influenced by the implementation of the SFDR on the EU financial markets, introduced to create transparency and comparability in sustainability-related reporting standards. Studying the short-term impact of this new regulation enables us to differentiate and provide new perspectives to previous literature on the topic by investigating if decreased information asymmetry of an asset's sustainability objective impacts investor demand for sustainable investments.

Lastly, our paper relates to the research on investor responses to classifications and ratings on the mutual fund market (see Del Guercio & Tkac (2008) and Hartzmark & Sussman (2019)). We add to this strand of literature by studying the potential shift in investor demand following the implementation of the EU's SFDR. In contrast to the previous literature on the topic, studying the immediate investor response to classifications, we observe the short-term development in investor preferences and demand following the introduction of the SFDR classifications.

3 Theoretical Background

To investigate the potential change in performance and value generation amidst the implementation of SFDR classifications, we provide a background of the underlying theory and concepts upon which we base our empirical analysis.

The early body of research measuring the skill of mutual fund managers has relied upon conventional alpha measures, such as Carhart (1997) who uses net alpha. However, Berk and Green (2004) argue that skill is a scarce resource, resulting in net alpha being driven to zero in equilibrium due to competition between investors. As such, investors do not earn any abnormal returns. Moreover, they argue that active fund managers face decreasing returns to scale, meaning that it is increasingly difficult for fund managers to generate net alpha with a growing fund size. Therefore, many researchers hypothesized that gross alpha should instead be used to measure managerial skill. In response, Berk and van Binsbergen (2015) point out that if net alpha is equal to zero in a competitive equilibrium, this immediately implies that gross alpha will equal the fee charged to investors. Thus, they provide an argument for why gross alpha

does not measure skill either, but rather measures return. Building upon the theory provided by Berk and Green (2004) they propose mathematically that decreasing returns to scale in an active fund manager's gross alpha follows the below relationship.

$$\alpha_i^* = a_i - b_i q$$

In the equation, α_i^* represents the gross alpha generated by the active fund manager, a positive a_i is the gross alpha earned on the first invested unit of capital, b_i measures decreasing returns to scale and q is the size of the actively managed capital. This equation shows that α_i^* is decreasing in q, and since b_i is greater than zero, gross alpha generally falls when a fund manages more capital. Given this relationship, Berk and van Binsbergen (2015) propose value added, the product of the benchmark-adjusted gross excess return and inflation adjusted lagged assets under management, as the accurate measure of skill. As opposed to conventional alphas, measuring the abnormal return of the mutual fund, value added is an absolute measure that considers the fund size and quantifies the total value extracted from the market by a mutual fund manager. The method underlying our empirical analysis, outlined in Section 5, builds upon this framework proposed by Berk and Binsbergen (2015), where conventional alpha measures are used to evaluate the performance of an actively managed mutual fund and value added is used to measure managerial ability to generate value.

4 Data

This section details the data used in our empirical analysis. In the first subsection, we outline our data sources and in the second subsection, we explain the rationale and procedure behind our sample selection. The third subsection explains our data cleaning process along with Figure 1 displaying the geographical domiciles of the equity mutual funds in our sample. In the fourth subsection we construct the variable mutual fund flows and provide summary statistics.

4.1 Data Sources

Our primary source of fund data is the Refinitiv Eikon database. We choose this database as it is commonly used in both industry and academia. Furthermore, the Lipper database we accessed through Refinitiv Eikon has been used in previous research on mutual funds due to its large coverage (see Demirci, Ferreira, Matos & Sialm (2022) and Cremers, Ferreira, Matos & Starks (2016)). Secondly, we collect data on European Fama-French-Carhart factors for benchmark estimation along with the risk-free rate from the Kenneth French data library (2024). This data library contains a wide array of geography-specific factors and portfolio sorts provided by Kenneth French. All data retrieved is expressed monthly and denominated in USD. Thirdly, we collect US CPI data from the U.S. Bureau of Labor Statistics to adjust fund size and fund flows for inflation.

4.2 Sample Selection

In this paper, we examine actively managed European equity mutual funds that are notified for sale in Sweden for two main reasons. First, the corresponding literature of European mutual funds is scarce in comparison to the US mutual fund market. Second, as Ibert, Kaniel, Van Nieuwerburg and Vestman (2018) argue, Sweden represents a suitable market to conduct analyses as motivated through, for instance, its depth and competition, in addition to being one of the foremost countries in terms of aggregate industry size relative to GDP. Hence, the

Swedish mutual fund market represents an appropriate market for analyzing the implementation of the SFDR in the EU.

In generating a raw sample, we screen for all actively managed equity mutual funds notified for sale in Sweden in Refinitiv Eikon. From the screen we use data on current share class identifier and name, SFDR classification, primary share class identifier and name, domicile, and launch date. We then proceed to retrieve data on monthly net rolling returns for all share classes, total expense ratios (TER) for the primary share classes, and total net assets (TNA) for all share classes in our data set since first reported. Net rolling returns measure a share class' monthly net returns, TNA measures the total value of a share class' underlying holdings and TER measures the charged amount of fees and expenses to the investor. All returns and TNA data are denominated in USD. Before data cleaning, we have 2 710 primary share classes and 20 067 share classes in total.

In our analysis, we have used the SFDR classification of the funds as of March 5 2024, the latest available data on the classifications. The reason for this is that when the SFDR was first implemented, there was uncertainty regarding the relative requirements for the different classifications. Thus, the EU released additional details of these requirements, which prompted reclassifications for funds that did not fulfill the stipulated requirements (Bioy, 2021, European Commission, 2023). Therefore, the latest available SFDR classifications most accurately reflects the actual sustainability objectives of the mutual funds and is hence the most appropriate to use in our analysis. The respective SFDR classifications are defined as follows (The European Parliament and the Council of the European Union, 2019):

- Article 6: Products without an explicit sustainability objective.
- Article 8: Sustainability is not explicitly a primary investment objective, but the products promote and consider sustainability.
- Article 9: Products that have sustainability as an explicit primary investment objective.

Furthermore, in Refinitiv Eikon we screen for passively managed equity mutual funds notified for sale in Sweden and collect data on net rolling returns for benchmark estimations. We will detail our choices of benchmark estimations in Section 5; benchmarks based on a set of 10 passive Vanguard funds and based on the FFC factors.

4.3 Data Cleaning

Since we are interested in how actively managed equity mutual funds of each SFDR classification developed during the period from the passing (November 27th, 2019) to the implementation of the regulation (March 10th, 2021), compared to the subsequent period, we focus our analysis on these two subperiods. Using month end data, the two periods of interest are November 2019 until February 2021 and March 2021 until June 2022. Thus, the sample totals 32 months equally split between the two periods. When we refer to the "pre-period" or the "post-period", we hence refer to these two respective subperiods.

TNA data in Refinitiv Eikon is reported on a per share class basis. We therefore sum the monthly TNA across the share classes belonging to the same primary share class and input the estimated fund size to the primary share class. In line with Berk and van Binsbergen (2015), we adjust the estimated fund size for inflation and include only months from which the fund

exceeds USD 5 million. However, since we construct a balanced sample, we require the fund to have reached USD 5 million in fund size already in the month before the pre-period starts, thereby reducing the risk that results are distorted by small fund sizes. Furthermore, it ensures that we can calculate value added in the first month using lagged fund size. In adjusting fund size for inflation, we use the US CPI data to express fund size in 2020-01 USD. The choice of base month corresponds to the relevant period of analysis. As of this step our data set includes 1 591 actively managed equity mutual funds, whereof 290 belong to Article 6, 1 207 to Article 8 and 94 to Article 9.

We proceed to compute the weighted net returns of the total fund using TNA share class weights (Cooper, Halling & Yang, 2021). Demirci et al. (2022) who use the Lipper database establish that all share classes that belong to the same fund have the same holdings and gross returns. The fact that it is mainly the amount of fees and expenses that separate share classes within a fund is widely documented (see for example Berk & van Binsbergen (2015)). Thus, the monthly total expense ratio of the primary classes is added to the corresponding net returns to compute the gross return of the full fund. Total expense ratios are predominantly reported yearly. Therefore, we assume each primary share class charges the same total expense ratio from investors from the month in which it is reported in the database until the next reported total expense ratio, allowing values dating back to 2018. Next, we calculate gross- and net excess returns using the risk-free rate.

To ensure a fully cleaned and balanced data set, we require each fund to have data on SFDR classification, lagged fund size, gross excess returns and net excess returns for each month during our 32 months of analysis. Our cleaned and balanced data set contains 1 489 funds in total, of which 275 are classified as Article 6, 1 132 as Article 8 and 82 as Article 9. In total, the sample contains 47 648 observations. We demonstrate the distribution of the number of funds by SFDR classifications and domicile in Figure 1.

Figure 1: Number of Funds by Domicile and Classification

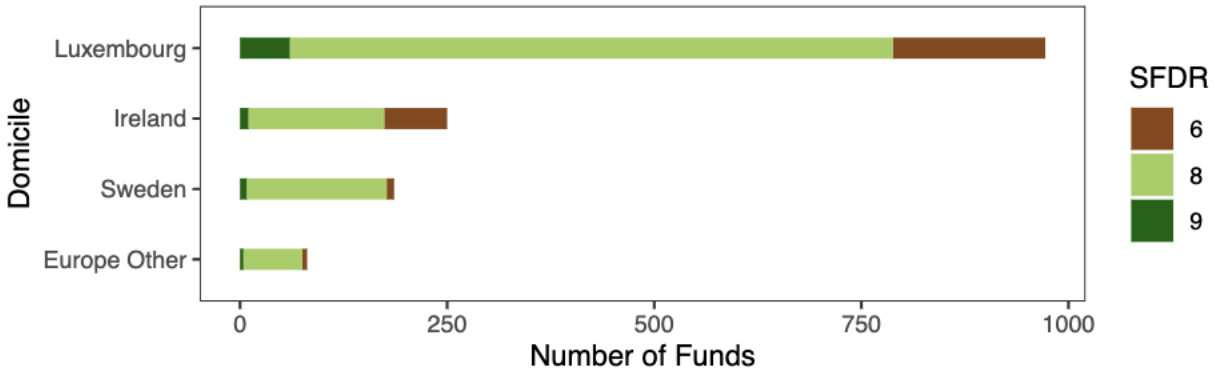


Figure 1. The figure represents the number of funds per each SFDR classification across domiciles. Europe Other represents domiciles with less than 50 funds.

4.4 Variable Construction

Based on the cleaned and balanced data set, we construct monthly net flows by altering the formula proposed by Sirri and Tufano (2002) to express flows in absolute terms, rather than percentage flows.

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

In (1), $FLOW_{i,t}$ measures the absolute level of net fund flows for each actively managed fund i for each month t, $TNA_{i,t}$ is the total net assets of fund i in month t, $TNA_{i,t-1}$ is the total net assets of fund i in month t-1 and $R_{i,t}$ is the net return of each fund i. Hence, (1) measures the growth in fund size beyond that of the fund's return, which is thus attributable to fund flows assuming reinvestment of dividends. Below we provide summary statistics.

Table 1: Summary Statistics

SFDR	Mean	Median	p20	p80	Std.dev	Observations	Funds
Net Flows							
6	-1.89	-0.50	-4.22	1.60	12.29	8800	275
8	1.66	-0.17	-4.91	5.21	22.11	36224	1132
9	13.85	3.22	-0.21	16.66	29.09	2624	82
TNA							
6	429.53	166.18	47.87	547.82	758.93	8800	275
8	825.43	340.36	84.55	1173.88	1409.32	36224	1132
9	684.12	260.32	73.69	929.27	1212.13	2624	82
Gross Alpha							
6	10.42	7.82	-15.21	40.85	49.15	8800	275
8	10.52	8.24	-13.28	33.71	35.59	36224	1132
9	30.00	19.32	-2.92	50.14	60.17	2624	82
Total Expense Ratio							
6	15.22	15.51	13.23	17.66	3.97	8800	275
8	13.97	14.72	11.74	16.42	3.67	36224	1132
9	14.38	14.96	12.57	16.75	3.48	2624	82
Net Alpha							
6	-2.39	-2.37	-29.84	29.83	49.15	8800	275
8	-1.05	-2.39	-23.82	21.49	35.30	36224	1132
9	17.34	6.84	-12.99	40.28	60.52	2624	82
Value Added							
6	-0.31	0.03	-0.34	0.53	6.75	8800	275
8	0.63	0.04	-0.62	1.02	5.63	36224	1132
9	1.64	0.09	-0.29	1.85	5.36	2624	82

Note:
The table displays summary statistics by SFDR classification. All measures are calculated based on the monthly mean of each fund over the full period. Net Flow, Total Net Assets (TNA) and Value Added are expressed in 2020-01 MUSD. Gross Alpha, Total Expense Ratio and Net Alpha are expressed in basis points (b.p). Alpha measures and Value Added are based on the Vanguard benchmark methodology. Note that statistics of Total Expense Ratio are solely for primary share classes.

5 Methodology

The methodology used in our empirical analysis is outlined in this section. The first subsection describes the equations used to derive performance measurements and managerial skill. The second subsection details our choices and estimations of benchmarks, and the third subsection describes how we conduct the paired sample t-test to investigate the intra-classification development in the dependent variables, which include TNA, gross alpha, net alpha, and value

added, in the period before and after the implementation of the SFDR. The fourth subsection specifies the difference-in-differences model we use to understand whether the intra-classification changes in the dependent variables is significantly different across classifications.

5.1 Measuring Performance and Value Added

Outlined below, we detail how we measure performance and managerial skill by following the methodology proposed by Berk and van Binsbergen (2015). This subsection is entirely based upon their methodology except from a minor deviation that is explicitly stated.

Investor return can be separated into the return of the next best investment alternative and the benchmark deviation ε_{it} of the return. In the following equation, R_{it}^{n} is the net excess return of an actively managed fund each month and R_{it}^{B} is the benchmark net excess return.

$$R_{it}^{n} = R_{it}^{B} + \varepsilon_{it}$$

With an observable benchmark return, the net alpha $\hat{\alpha}_i^n$ is hence estimated as follows, where T_i marks the number of months in each of the two sub periods.

$$\hat{\alpha}_i^n = \frac{1}{T_i}\sum_{t=1}^{T_i}(R_{it}^{n} - R_{it}^{B}) = \frac{1}{T_i}\sum_{t=1}^{T_i}\varepsilon_{it} \tag{2}$$

To compute the gross excess returns underlying gross alpha, the lagged fees and expenses $f_{i,\,t-1}$ are added to the net excess returns for each fund in each month.

$$R_{it}^{g} \equiv R_{it}^{n} + f_{i,\,t-1} = R_{it}^{B} + \varepsilon_{it} + f_{i,\,t-1}$$

Thus, the estimated gross alpha $\hat{\alpha}_i^g$ is defined according to the below. As such, T_i again is the number of months in each of the sub periods.

$$\hat{\alpha}_i^g = \frac{1}{T_i}\sum_{t=1}^{T_i}\left(R_{it}^{g} - R_{it}^{B}\right) = \frac{1}{T_i}\sum_{t=1}^{T_i}\left(f_{i,\,t-1} + \varepsilon_{it}\right) \tag{3}$$

The above equations measure performance. To measure value generation, return measures must be considered together with fund size. Value added is thus calculated as the product of inflation-adjusted lagged assets under management (AUM) and the benchmark adjusted gross excess return.

$$V_{it} \equiv q_{i,\,t-1}\left(R_{it}^{g} - R_{it}^{B}\right) = q_{i,\,t-1}f_{i,\,t-1} + q_{i,\,t-1}\varepsilon_{it}$$

Due to lacking data availability on AUM, we follow multiple papers that have instead used total net assets (TNA) as a measure of fund size in the value-added calculation (see Cooper et al. (2021) and Demirci et al. (2022)). Hence, the equation we use for calculating value added in each month for each fund is based on lagged TNA ($TNA_{i,\,t-1}$).

$$V_{it} \equiv TNA_{i,t-1}\left(R_{it}^{g} - R_{it}^{B}\right) = TNA_{i,t-1}f_{i,t-1} + TNA_{i,t-1}\varepsilon_{it}$$

Here from, we return to Berk and van Binsbergen (2015) to measure managerial skill as the expected value of the realized value added V_{it}.

$$S_i \equiv E[V_{it}]$$

Hence, it follows that, over T_i periods, managerial skill is the fund's mean realized value added. Then, over T_i periods, the fund's mean monthly value added is estimated as follows. We calculate the mean monthly value added for each fund in each of our two sub periods.

$$\hat{S}_i = \sum_{t=1}^{T_i} \frac{V_{it}}{T_i} \tag{4}$$

Thus, among N funds, the estimated cross-sectional mean of value added is calculated according to the below equation. As we calculate the mean value added for each classification, N is the number of funds in each classification.

$$\bar{S} = \frac{1}{N}\sum_{i=1}^{N} \hat{S}_i$$

5.2 Estimating Benchmarks

In determining the value that each fund generates or destroys, it is fundamental to compare the fund's performance relative to a benchmark (Berk & van Binsbergen, 2015). The fund's benchmark represents the next best investment that the investor is exposed to at each point in time. In other words, the investor should be able to invest in this benchmark at the same time as the investor can choose to invest in the actively managed fund. Given that the benchmark returns are unknown, these benchmarks must be chosen and estimated accordingly. In this paper, we estimate two types of benchmark excess returns R_{it}^{B}; portfolios based on passively managed Vanguard funds and portfolios based on Fama-French-Carhart factors (Berk & van Binsbergen, 2015).

5.2.1 Vanguard Benchmarks

With the reputation of passively managed Vanguard funds offering the lowest cost alternatives, we build on Berk and van Binsbergen (2015) set of passive Vanguard funds but alter their set by using Vanguard funds domiciled in Europe.

Our selection of passively managed Vanguard funds is shown in Table 2. First, we ensured that all Vanguard funds were launched before the period considered, notified for sale in Sweden, and have returns for all months in our period considered. Second, by combining the Morningstar Style Box™, measuring the asset class of each Vanguard fund, and Geographical Focus, each Vanguard fund covers different types of stock.

Table 2: Vanguard Benchmark Set

Asset Name	Launch Date	Geographical Focus	Morningstar Style Box(TM)
Vanguard ESG Developed Wld All Cap Eq Idx USD Acc	2014-09	Global	Large-Growth
Vanguard Emerging Markets Stock Index USD Acc	2014-02	Global Emerging Markets	Large-Blend
Vanguard European Stock Index USD Acc	1998-09	Europe	Large-Blend
Vanguard Eurozone Stock Index USD Acc	2014-02	EuroZone	Large-Blend
Vanguard Global Small-Cap Index USD Acc	2009-12	Global	Small-Blend
Vanguard Global Stock Index USD Acc	1998-08	Global	Large-Blend
Vanguard Japan Stock Index USD Acc	2003-10	Japan	Large-Blend
Vanguard Pacific ex-Japan Stock Index USD Acc	2005-07	Asia Pacific ex Japan	Large-Value
Vanguard SRI European Stock USD Acc	2014-09	Europe	Large-Blend
Vanguard U.S. 500 Stock Index USD Acc	1998-11	United States of America	Large-Growth

Note:
Selected Vanguard Benchmarks. Launch date corresponds to the month in which the fund was launched. Information on Morningstar Style Box(TM) is retrieved from Morningstar's website (2024).

Using the net excess return R_t^j of each Vanguard fund j throughout the 32 months, the benchmark return R_{it}^B of each actively managed fund i is estimated by:

$$R_{it}^B = \sum_{j=1}^{10} \beta_i^j R_t^j \tag{5}$$

β_i^j represents the portfolio weights that each Vanguard fund j is assigned in constructing the benchmark return for each actively managed fund i. Since the benchmark return of each actively managed fund i is the return of its benchmark portfolio, and since the sum of portfolio weights in any portfolio must be one, the sum of portfolio weights of each Vanguard fund must also be one. The benchmark portfolio weights in each actively managed fund's benchmark portfolio are therefore estimated iteratively through constrained linear regressions of the net excess returns of fund i over the 32 months onto the net excess returns of each of the 10 Vanguard funds. This yields 10 benchmark portfolio weights for each actively managed fund i, together adding to 1. Each benchmark portfolio weight of fund i with respect to Vanguard fund j is then used in estimating the benchmark net excess return R_{it}^B according to (5).

5.2.2 Fama-French-Carhart (FFC) Benchmarks

The second type of benchmark portfolio is estimated using the four factors put forward by Fama and French (1995) and Carhart (1997). Through this approach, the benchmark portfolio of the actively managed fund i is a portfolio with equally risky returns as fund i itself (Berk & van Binsbergen, 2015). The excess benchmark return R_{it}^B is estimated as follows:

$$R_{it}^B = \beta_i^{MKT} MKT_t + \beta_i^{SML} SML_t + \beta_i^{HML} HML_t + \beta_i^{UMD} UMD_t \tag{6}$$

In this relationship, the factors MKT_t, SML_t, HML_t and UMD_t correspond to market excess return, small minus big, high minus low and the momentum factor, respectively. The beta coefficients are first estimated by regressing the net excess returns of each actively managed fund onto each of the four factors over the 32 months in our data set. Then, the beta coefficients of each actively managed fund i is multiplied by the corresponding factor to compute the benchmark excess return using (6).

The FFC benchmark methodology does, however, not take transaction costs into consideration (Berk & van Binsbergen, 2015). It hence follows that benchmark returns disregarding transaction costs, ceteris paribus, will estimate a higher benchmark return than if transaction

costs were accounted for as in the case of Vanguard benchmarks. Furthermore, the FFC factors are based on Europe as a geographical area. Because the SFDR is implemented through the EU and all funds in our clean sample are domiciled in Europe, we believe that using European FFC factors is the most appropriate. However, there is a risk that the European FFC factors do not accurately reflect risk in the fund's geographical focus areas. Given the shortcomings of the FFC benchmark methodology, we conduct our main analysis using the Vanguard benchmark methodology. The FFC benchmark methodology is instead used to evaluate the robustness of our empirical results.

5.3 Paired Sample T-Tests

For each fund in our sample, we calculate the mean of total net assets in each of the periods. The values for gross alpha, net alpha and value added (equation (3), (2) and (4), respectively) are already calculated as mean measures for each fund. With the respective mean measures of each fund during both the pre-period and post-period we compute our corresponding difference measures. This allows us to test the means of all difference measures within classifications. It hence follows that the mean difference measures all demonstrate the change amidst the implementation of classifications for each respective SFDR classification. The mean difference in dependent variables within classifications builds on the following formula, where *t* is the test statistic, $\bar{d}$ measures the average difference in dependent variables among funds in the same classification, $\hat{\sigma}$ is the sample standard deviation of the difference and n marks the number of funds within a classification. Based on this, we report the mean differences, p-values and standard errors.

$$t = \frac{\bar{d} - 0}{\hat{\sigma}/\sqrt{n}}$$

5.4 Difference-in-Differences

With the quantified change of dependent variables intra classification, we proceed to quantify if the change of each dependent variable is different across classifications using a difference-in-differences methodology. As previously discussed, Article 8 funds consider sustainability in their investment decisions, but it is not their primary investment objective. In contrast, Article 6 funds have no sustainability objective while Article 9 funds have sustainability as their primary objective. As such, Article 8 funds is therefore a category in between Article 6 and 9 funds when it comes to relative sustainability focus. We therefore compare the changes of Article 6 and 9 funds relative to the changes of Article 8 funds, respectively, which makes Article 8 funds the omitted category.

$$Y_{i,t} = \beta_1 + \beta_2 \cdot SFDR\ 6_i + \beta_3 \cdot SFDR\ 6_i \cdot Post + \beta_4 \cdot SFDR\ 9_i + \beta_5 \cdot SFDR\ 9_i \cdot Post + T_t + \varepsilon_{i,t} \quad (7)$$

In (7), SFDR 6_i and SFDR 9_i are dummy variables taking the value 1 if the fund is classified as Article 6 or 9, respectively. Post is a dummy variable that takes the value 1 if the observation is in the post period and T_t marks time fixed effects. It is important to include time fixed effects because our sample period spans a volatile macroeconomic period.

6 Results

Our empirical results are presented as follows. The first subsection provides an overview of the development in investor demand, as reflected in mutual fund flows, and the relative growth in fund size for the respective classifications over both subperiods. In the second subsection, we display the results of the paired sample t-tests to analyze the intra-classification development in the dependent variables. In the third subsection, we present the results from our difference-in-differences models, aiming to conclude if the intra-classification development in the dependent variables between the two periods is significantly different across classifications. The fourth subsection contains the detailed analysis of the explanatory power of cross-sectional differences in gross alpha of the cross-sectional variation in value added. In the fifth subsection, we show the robustness of our results using the FFC benchmark methodology. In the sixth subsection, we further discuss and interpret the implications of our empirical findings.

6.1 Mutual Fund Flows and Fund Size

In Figure 2, we display monthly fund flows adjusted for inflation for each SFDR classification.

Figure 2: Average Estimated Net Flows by SFDR Classification

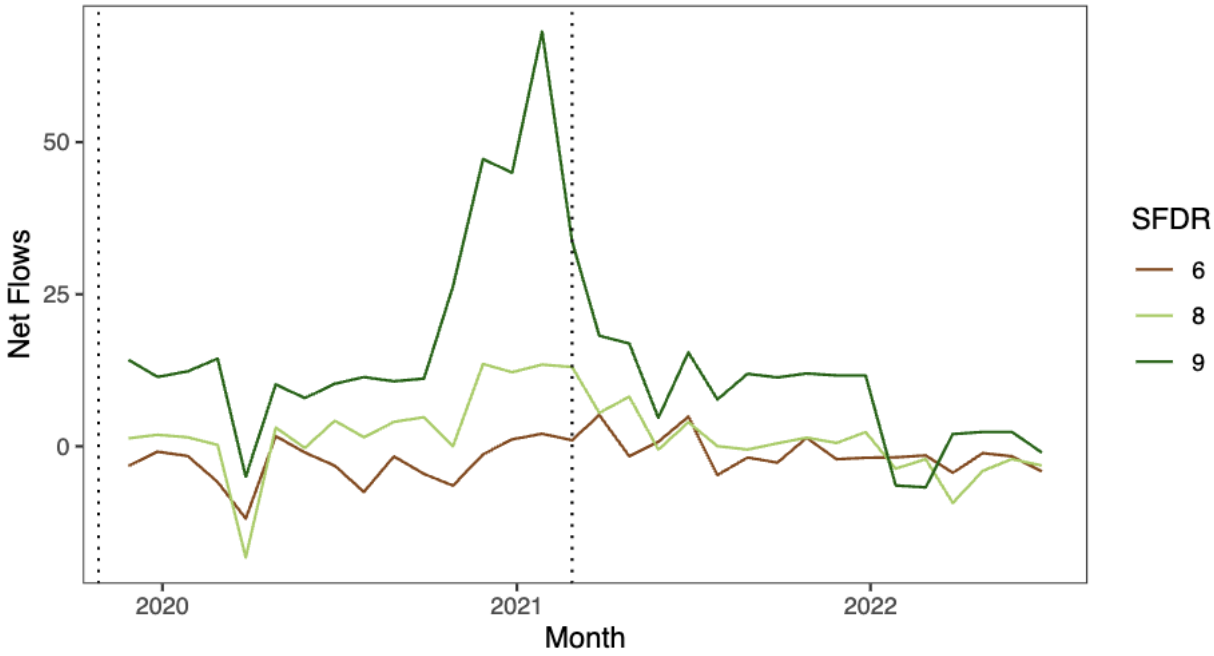


Figure 2**.** Average monthly estimated fund flows per SFDR classification. The first dotted line represents the month-end of October 2019 just before the regulation was passed. The second dotted line represents the month-end of February 2021 just before the SFDR classifications were required to be published. The period considered is month-end November 2019 to month-end June 2022. All measures are given in 2020-01 MUSD.

Figure 2 shows that Article 9 funds have attracted greater average capital inflows relative to Article 6 and 8 funds, reflecting high investor demand for sustainable assets during the period. Moreover, we can observe that the inflow of capital for Article 9 funds spiked between the late 2020 and early 2021, before the classifications were required to be released. We attribute these large spikes in capital inflows during the ending months of 2020 to be partly related to a

recovery package that came as a response to the economic downturn caused by Covid-19. The European Commission proposed a recovery package in May 2020 that was passed in November 2020 by the European Parliament and the Council. Out of this stimulation package, a considerable amount was devoted to address climate change (European Commission, 2020). However, there are additional possible explanations for the great inflow of capital starting before the date that the classifications were required to be released. For example, funds might have announced their classification before this date, investors anticipated an increase in value of sustainable assets following the passing of the regulation, or that investors with sustainability preferences were already informed about the relative sustainability objectives of funds. Most likely, all the above explanations have contributed to the large demand for Article 9 funds that we can see in Figure 2, and we will discuss these in further detail in subsection 6.

In addition, we can see that the fund flows for Article 6 and 8 funds on average have been relatively stable amidst the implementation of the SFDR classifications in contrast to Article 9 funds that experienced substantial capital inflows. However, Figure 2 indicates that Article 8 funds have attracted relatively more capital on average than Article 6 funds around the time of the implementation of the classifications. Article 6 net fund flows on average lie close to zero throughout the period, implying low investor demand. The capital outflows for all fund classifications observable in Figure 2 during the early 2020 and 2022 are attributed to the capital market reaction to the outbreak of Covid-19 and the Russian invasion of Ukraine, respectively.

To observe how the capital inflows relate to the development in fund size for the respective classifications, we have plotted the cross-sectional monthly mean of fund size for each classification separately in Figure 3 for both the pre- and post-period.

Figure 3: Cross-sectional Fund Size Post Regulation Passing by Classification

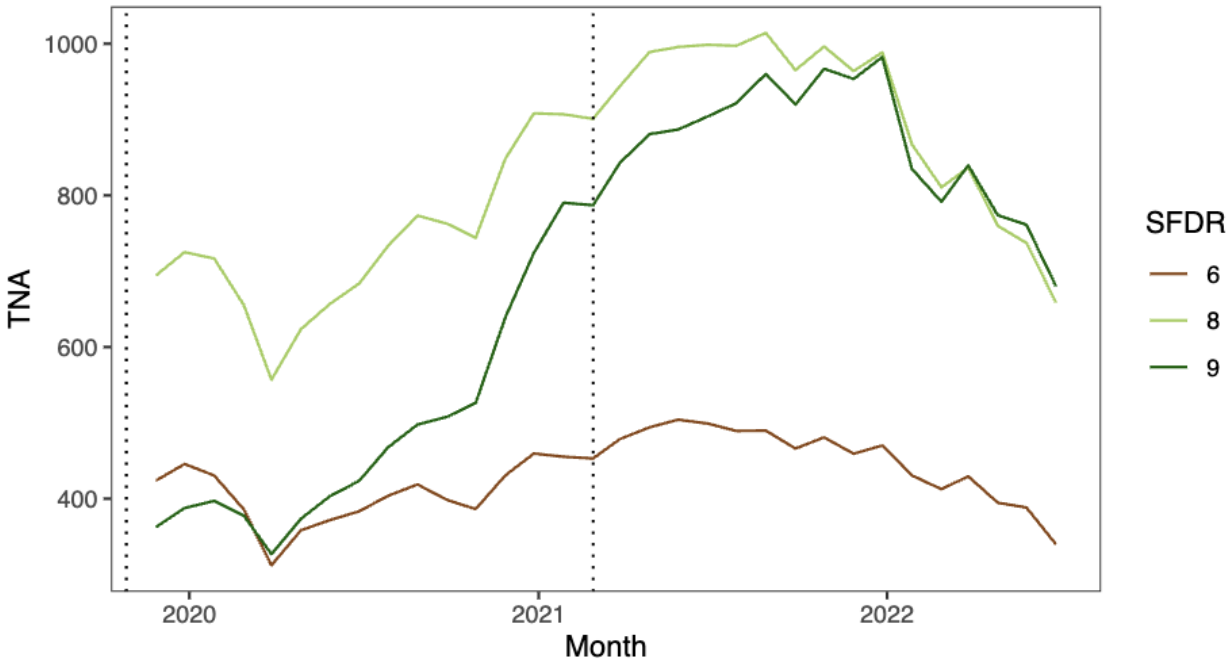


Figure 3**.** The figure represents the cross-sectional mean of fund size as measured by inflation-adjusted cross-sectional mean of the respective SFDR classifications. The period considered is from November 2019 to June 2022. The first dotted vertical line represents month-end October 2019 and the second dotted¨ vertical line represents month-end of February 2021. All measures are in 2020-01 MUSD.

In Figure 3, we can observe that both Article 8 and 9 funds grew rapidly on average in the pre-period, before classifications released, compared to the Article 6 funds. We can also observe that all classifications exhibited sharp declines in fund size during early 2020, related to the outbreak of the Covid-19 pandemic. In the recovery period, green funds grew quicker than brown funds, predominantly in the later part of 2020. Amidst the release of SFDR classifications in early March 2021, Article 8 and 9 funds again experienced growth in fund size, slowing down shortly thereafter. The fall in fund size for all classifications by 2022 occurs amidst the Russian invasion of Ukraine, which also coincides with capital outflows as seen in Figure 2.

Comparing Figure 2 and 3, we can observe that the capital inflows for Article 8 and 9 funds occur in tandem with the substantial increase in fund size for these classifications. This is particularly evident for the substantial increase in fund size for Article 9 funds, which implies that the growth in fund size is largely driven by capital inflows. However, it should be noted that fund size is not solely a result of capital flows as generated returns also have an impact. We will examine the fund performance in the following subsections.

To observe the percentage change in the average fund size, we scale the fund size by the cross-sectional average fund size of each classification separately by the month-ends just before the regulation passing (November 27th, 2019) and regulation implementation (March 10th, 2021) in Figure 4.

Figure 4: Scaled Fund Size Post Regulation Passing and Post Implementation

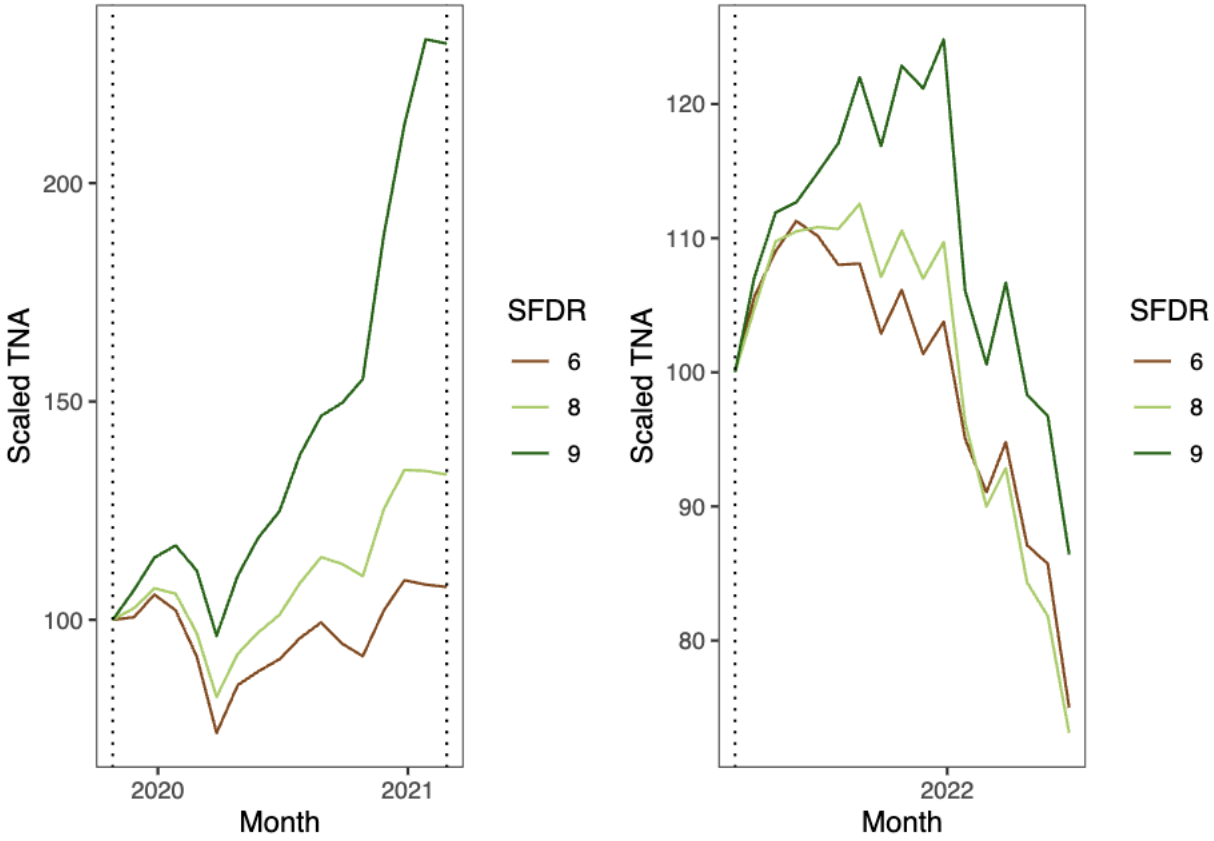


Figure 4. The left-hand side represents scaled TNA based on cross-sectional average fund size per SFDR classification as of month-end October 2019. The right-hand side represents scaled TNA based on cross-sectional average fund size per SFDR classification as of month-end February 2021. The first vertical line in the left plot is month-end October 2019 and the second vertical line is the equivalent of the first vertical line in the right plot, representing month-end February 2021.

Figure 4 shows a larger increase in scaled average cross-sectional fund size for Article 9 funds compared to the other two fund classifications both after the regulation release and after the classifications release. In the pre-period, Article 9 funds in the cross section more than doubled in fund size, while Article 6 and 8 funds experienced a marginal increase in fund size in comparison. We can also observe that the fund size grew more for the average Article 8 fund in comparison to the average Article 6 fund. When scaling the cross-sectional average fund size in the post period, all classifications continue to grow on average, with Article 9 experiencing a relatively higher growth, until the start of 2022. By the start of 2022, we can observe a large decline in average fund size for all fund classifications, which coincide with the Russian invasion of Ukraine.

Having studied how investor demand for the classifications, reflected in fund flows, relates to the development in fund size, we will investigate if this demand can be related to the relative performance of the classifications. Moreover, we investigate whether the significant substantial increase in fund size for Article 8 and 9 funds have resulted in decreasing returns to scale. More specifically, we are also looking to see if the commitment to higher investment constraints for the Article 9 funds, relative to Article 6 and 8 funds, can be observed through lower performance for these funds and deteriorating managerial ability to generate value.

6.2 Intra-Classification Differences

In Table 3, we display our results from the paired sample t-tests, analyzing the short-term development in fund size growth, performance measures and managerial skill for the respective classifications between the period before and after the SFDR implementation.

Table 3: Change of monthly dependent variables post SFDR implementation

	Pre: 201911-202102	Post: 202103-202206	Post - Pre Difference		
SFDR	Mean: Pre	Mean: Post	Mean Difference: Post-Pre	P-Value	Std.Err
TNA					
6	407.36	451.69	44.33	0.006	16.09
8	743.16	907.70	164.54	0.000	15.27
9	499.49	868.75	369.26	0.000	82.59
Gross Alpha					
6	9.21	11.63	2.42	0.682	5.91
8	24.48	-3.44	-27.92	0.000	2.21
9	38.44	21.56	-16.88	0.036	7.93
Net Alpha					
6	-2.13	-2.64	-0.52	0.931	5.94
8	13.66	-15.75	-29.41	0.000	2.22
9	27.79	6.89	-20.89	0.011	8.00
Value Added					
6	0.41	-1.02	-1.43	0.041	0.70
8	2.47	-1.21	-3.68	0.000	0.39
9	1.51	1.77	0.26	0.648	0.57

Note:
The mean of each fund's mean TNA, gross alpha, net alpha and value added for each SFDR classification over the respective time periods. Post - Pre Difference shows the mean change of the mean monthly dependent variables between the respective time periods, the P-Value of the change and the standard error or the change. The difference measures are based on paired sample t-tests. Alphas and values added are based on the Vanguard benchmark methodology. All mean alpha measures are expressed in basis points. All mean TNA and value added measures are expressed in 2020-01 MUSD.

In Table 3, we can see that all classifications have significantly increased their fund size on average between the period before and after the implementation of the classifications. These results align with the indications from the visual overview in Figure 3 and 4. The great magnitude of the increase in fund size for Article 9 funds appears to be largely driven by the substantial capital inflows for these funds as suggested in Figure 2, which reflect the investor demand for these highly sustainable assets. Article 8 funds have also experienced a relatively large increase in fund size between the two periods. The growth in the average Article 6 fund does not appear to be a result primarily driven by capital inflows, as Figure 2 indicate that the fund flows for this category lies close to zero throughout both the pre- and post-period. Thus, a more probable explanation for the increase in fund size for Article 6 is that it is primarily driven by returns.

The difference in the gross alpha measure between the pre-and post-period is negative with a large magnitude for both Article 8 and 9 funds, results that are statistically significant. Thus, for the average Article 8 and 9 fund, the ability to outperform the passive benchmark has deteriorated in the period after classifications were implemented. In contrast, the same relationship does not appear to hold true for Article 6 funds, for which we can see that the result for the difference in gross alpha between the two periods is insignificant. Hence, this implies

that the average Article 6 fund has not experienced any significant change in performance between the two periods. The results for the net alpha measure are consistent with the findings for gross alpha, confirming that the abnormal return net of expenses follows the same development as the abnormal return generated by the fund before expenses.

The results from the short-run development in fund size and gross alpha following the implementation of the SFDR aligns with our expectations of more assets being under management with sustainable objectives along with decreasing returns to scale for these relatively more sustainable funds. Earlier, we concluded that the substantial increase in fund size for Article 9 funds is primarily driven by capital inflows, representing high investor demand for these funds, which in turn has resulted in a deteriorating ability to outperform the passive benchmark. The fact that we see this same development for Article 8 funds that also experienced a relatively large increase in fund size, along with having a certain degree of investment constraints, is also aligned with our expectations. Not surprisingly, the gross alpha for Article 6 funds, that both lack investment constraints due to sustainability commitments and experienced a relatively small increase in fund size, have not decreased in the post-period. Thus, this supports our argument of decreasing returns to scale, as the short-run development for these funds does not appear to have been impacted amidst the implementation of the SFDR in contrast to the development for the other classifications.

For value added, we can see that the difference between the periods is significant and negative for both Article 6 and 8. Given that Article 6 funds did not significantly change their gross alpha on average between the two periods, this result must imply that there are funds with a large fund size within the classification that generate a negative gross alpha in the post-period. Hence deteriorating the development in value generation for the classification. For Article 9, we can see that the value extracted from the market has not significantly changed between the two periods. This result, as well as the result for Article 6, contradicts that of our results for the alpha measures. Our value added results show that while Article 9 experienced diminishing returns to scale between the periods, the substantial increase in fund size in the period after classifications resulted in there being no significant difference in the average fund's ability to extract value from the market.

6.3 Difference-in-Differences

In Table 4, we display our results from the difference-in-differences regressions, testing if the short-term intra-classification development between two periods displayed in Table 3 has been significantly different across classifications.

Table 4: Difference-in-Differences regressions: Article 6 and 9 relative to Article 8

	TNA	Gross Alpha	Net Alpha	Value Added
Pre Difference: SFDR 6	-335.8***	-15.27***	-15.78***	-2.06***
	(22.73)	(3.42)	(3.42)	(0.51)
SFDR 6 x Post	-120.21***	30.35***	28.9***	2.25**
	(32.14)	(4.84)	(4.83)	(0.72)
Pre Difference: SFDR 9	-243.66***	13.96*	14.13*	-0.96
	(38.66)	(5.82)	(5.82)	(0.87)
SFDR 9 x Post	204.71***	11.04	8.52	3.94**
	(54.67)	(8.23)	(8.22)	(1.23)
Time Fixed Effects	Yes	Yes	Yes	Yes
Adj. R-Squared	0.02036	0.03312	0.03277	0.01664
Observations	47648	47648	47648	47648

Note:
The table displays the difference-in-differences results for SFDR 6 and SFDR 9 relative to SFDR 8, respectively. Our dependent variables includes TNA, gross alpha, net alpha, and value added. Alpha measures are expressed in basis points. TNA and value added are espressed in 2020-01 MUSD. The regressions include time fixed effects. Standard errors are reported in brackets. Significance levels: *** (0 - 0.001), ** (0.001 - 0.01), * (0.01 - 0.05).

Our difference-in-differences regressions in Table 4 confirm that both Article 6 and 9 funds are significantly smaller than Article 8 funds in the pre-period. Furthermore, also with a highly significant result, we can confirm that the change in fund size between the periods is considerably smaller on average for Article 6 funds relative to Article 8 funds. The opposite relationship holds true for the average Article 9 fund, that experienced a substantially larger growth in fund size than the average Article 8 fund in the period after classifications. This result is also highly significant, demonstrating an increasing demand for relatively more sustainable funds amidst the implementation of the classifications.

While we could observe in the first subsection that periods of substantial increases in fund size correspond to periods with high capital inflows for the classifications 8 and 9, we can also attribute this growth to relatively stronger performance of these funds in the pre-period. Looking at the gross and net alpha in Table 4, we can see that Article 6 funds performed significantly worse than Article 8 funds in the pre-period. Furthermore, the average Article 9 fund performed significantly better in the pre-period than the Article 8 fund. These results have implications for the growth in fund size, being that the substantial increase in fund size could be driven by high returns for the relatively more sustainable fund classifications. These results may also suggest that the relatively higher capital inflows before the classifications for Article 8 and 9 funds could be motivated by a significantly better performance in the pre-period relative to Article 6 funds.

However, looking at the interaction term for Article 6, it is positive with a large magnitude, and highly significant. This result in combination with the findings in Table 3, confirms that Article 6 performance development has been superior relative to that of Article 8 between the two periods. Furthermore, the average Article 9 fund performed significantly better in the pre-period than the Article 8 fund. However, the interaction term for Article 9 is insignificant, which implies that we cannot conclude with certainty that the short-run development in performance has been different for these two fund classifications following the SFDR

implementation. Thus, we do not find support for our expectation of a stronger short-term effect of decreasing returns to scale for funds with the highest self-imposed investment constraints.

By observing the pre-period difference in value added, we can conclude with certainty that Article 8's ability to extract value from the market was higher relative to Article 6 in the period before classifications. However, the interaction term for Article 6 is positive and significant. From Table 3 we learned that both classifications saw a negative mean development in value added between the pre- and post-period. Thus, we can conclude that the development in the managerial ability to generate value for Article 8 funds has declined more than for Article 6 funds. The pre-period difference between Article 9 and Article 8 funds indicates that there is no significant difference in the value these funds were able to extract from the market in the pre-period. However, the interaction term is positive with a large magnitude and significant. Acknowledging this, combined with the significant decrease of value added for Article 8 funds between the periods (Table 3), we can conclude that the ability of the average Article 9 manager to uphold value generation between the two periods is superior to that of the Article 8 fund manager. Thus, according to Berk and van Binsbergen (2015), the average Article 9 fund manager is to be considered more skilled than the average Article 8 fund manager in the post-period.

6.4 Explanatory Power of Cross-Sectional Variation

In Table 5, we display the results of the cross-sectional correlation and R-squared between mean gross alpha in (3) and mean value added in (4) for each SFDR classification. These results show the explanatory power of variation in gross alpha in the variation of value added in the cross-section. We also demonstrate the cross-sectional explanatory power of variation in gross alpha changes, of the variation in value added changes.

Table 5: Explanatory Power of Gross Alpha with respect to Value Added in the Cross-Section

	201911-202102		202103-202206		Post - Pre Difference	
SFDR	Correlation	R-Squared	Correlation	R-Squared	Correlation	R-Squared
6	0.42	0.18	0.54	0.29	0.49	0.24
8	0.49	0.24	0.48	0.23	0.48	0.23
9	0.56	0.32	0.50	0.25	0.19	0.04

Note:
The cross-sectional correlation and R-squared between gross alpha and value added within each SFDR classification over given periods. Post - Pre Difference refers to the cross sectional correlation between change in value added and change in gross alpha. Measures are calculated based on the mean gross alpha and mean value added of each fund over given periods. Correlations and R-squared are displayed using the Vanguard benchmark methodology.

In Table 5, we can observe that the explanatory power of gross alpha in value added is small across periods and classifications. Thus, in line with Berk and van Binsbergen (2015) we can conclude that cross-sectional differences in fund size is the primary driver of cross-sectional differences in value added. Furthermore, the explanatory power of cross-sectional differences in gross alpha changes of the cross-sectional variation in value added between the pre- and post-period is also small. For Article 9 funds, we can see that the explanatory power of the variation in gross alpha in the changes in value added in the cross-section is very low, only 4%, between the pre- and post-period. This implies that there is high cross-sectional variation in

fund size development amidst the SFDR implementation relative to the cross-sectional variation of development in gross alpha. We can see that this relationship holds true for Article 6 and 8 funds as well, although the explanatory power of gross alpha is higher with 24% and 23% respectively for these classifications. These results indicate that the larger the increase in fund size, the lower the cross-sectional differences in gross alpha. This finding further supports our results associating substantial increases in fund size with decreasing returns to scale.

6.5 Robustness of Results

We test the robustness of our results displayed in Table 3-5 through employing the FFC factors as an alternative benchmark methodology for calculating gross alpha, net alpha and value added, in line with Berk and van Binsbergen (2015).

Table 6: Change of monthly Alphas and Value Added post SFDR implementation (FFC)

	Pre: 201911-202102	Post: 202103-202206	Post - Pre Difference		
SFDR	Mean: Pre	Mean: Post	Mean Difference: Post-Pre	P-Value	Std.Err
Gross Alpha					
6	5.75	-1.93	-7.68	0.336	7.97
8	15.33	-4.57	-19.91	0.000	3.41
9	23.64	21.13	-2.51	0.836	12.08
Net Alpha					
6	-5.59	-16.20	-10.62	0.180	7.90
8	4.51	-16.89	-21.39	0.000	3.41
9	12.99	6.46	-6.53	0.596	12.25
Value Added					
6	-0.46	-0.13	0.33	0.685	0.82
8	1.97	-0.14	-2.11	0.000	0.59
9	0.80	2.70	1.89	0.232	1.57

Note:
The mean of each fund's mean gross alpha, net alpha and value added for each SFDR classification over the respective time periods. Post - Pre Difference shows the mean change of the mean monthly dependent variables between the respective time periods, the P-Value of the change and the standard error or the change. The difference measures are based on paired sample t-tests. Alphas and values added are based on the FFC benchmark methodology. All mean alpha measures are expressed in basis points. Value added measures are expressed in 2020-01 MUSD.

It can be observed in Table 6 that the decrease in gross alpha and net alpha for Article 9 funds that we observed using the Vanguard benchmark methodology is no longer statistically significant. This result is explained by the relatively larger average alphas for Article 9 funds in the post period relative to our previous findings. As Pástor, Stambaugh and Taylor (2022) show, the post period was a time of unexpected increases in environmental concerns in Europe. An unexpected component is uncaptured by risk factors which explains the higher alpha measures for Article 9 funds obtained using FFC compared to Vanguard benchmarks. Furthermore, it can be observed that value added does not fall on average for Article 6 funds, contradicting our result in Table 4.

Table 7: Difference-in-Differences: Monthly Alphas and Value Added relative to Article 8 (FFC)

	Gross Alpha	Net Alpha	Value Added
Pre Difference: SFDR 6	-9.59*	-10.10*	-2.43**
	(4.41)	(4.41)	(0.74)
SFDR 6 x Post	12.23*	10.78	2.44*
	(6.24)	(6.23)	(1.05)
Pre Difference: SFDR 9	8.31	8.48	-1.16
	(7.50)	(7.50)	(1.26)
SFDR 9 x Post	17.39	14.87	4.00*
	(10.61)	(10.60)	(1.78)
Time Fixed Effects	Yes	Yes	Yes
Adj. R-Squared	0.13250	0.13185	0.03918
Observations	47648	47648	47648

Note:
The table displays the difference-in-differences results for SFDR 6 and SFDR 9 relative to SFDR 8, respectively. Our three dependent variables include monthly gross alpha, net alpha and value added, all based on the FFC benchmark methodology. Alpha measures are expressed in basis points. Value added is expressed in MUSD in 2020-01 USD. The regressions include time fixed effects. Standard errors are reported in brackets. Significance levels: *** (0 - 0.001), ** (0.001 - 0.01), * (0.01 - 0.05).

In evaluating the relative changes of Article 6 and 9 funds relative to Article 8 funds in Table 7, our difference-in-differences results using the FFC benchmark methodology confirms our findings for average relative changes in value added. The signs of the estimates are consistent with the previous findings, although the significance levels differ for the estimates of relative changes in alpha measures. However, it should be reiterated that FFC factors for Europe as whole does not necessarily correspond to the riskiness of the respective geographical focus areas of the mutual funds. Furthermore, one should keep in mind that FFC benchmarks do not take transaction costs into account (Berk and van Binsbergen, 2015). Article 9 funds did not on average change its value added, but relative to Article 8 funds who generated significantly less value added in the post period, it is evident that the managerial ability for Article 9 funds was superior to Article 8 funds in the period following the implementation of the SFDR. Recognizing the limitations of the FFC benchmark methodology while finding largely consistent results over both benchmark methodologies, we consider our results to robust for the relative changes in value added in connection to the implementation of the SFDR.

Table 8: Explanatory Power of Gross Alpha with respect to Value Added in the Cross-Section (FFC)

	201911-202102		202103-202206		Post - Pre Difference	
SFDR	Correlation	R-Squared	Correlation	R-Squared	Correlation	R-Squared
6	0.40	0.16	0.52	0.27	0.44	0.20
8	0.51	0.26	0.52	0.27	0.53	0.28
9	0.47	0.22	0.53	0.29	0.46	0.21

Note:
The cross-sectional correlation and R-squared between gross alpha and value added within each SFDR classification over given periods. Post - Pre Difference refers to the cross sectional correlation between change in value added and change in gross alpha. Measures are calculated based on the mean gross alpha and mean value added of each fund over given periods. Correlations and R-squared are displayed using the FFC benchmark methodology.

Under the Vanguard benchmark methodology, we found in Table 5 that cross-sectional differences in gross alpha had small explanatory power of cross-sectional differences in value added. Table 8 confirms this finding. In evaluating cross sectional variation in the change of value added following the SFDR implementation, Table 8 also supports that cross-sectional variation in gross alpha has limited explanatory power. However, using the FFC benchmark methodology, the explanatory power of variation in gross alpha changes is higher for Article 9 funds compared to the Vanguard benchmark methodology. This suggests that the FFC benchmark methodology produced higher cross-sectional variation in gross alpha changes. However, we find strong support confirming that cross-sectional variation in fund size is the primary driver of cross-sectional variation of value added.

In conclusion, we find that the FFC benchmark methodology confirms our previous results of relative changes of value added. Despite its limitations, the FFC benchmark methodology also shows that both the average Article 6 and 9 managers managed to uphold value generation significantly better than the average Article 8 manager following the SFDR implementation. Further, we find support for our finding that cross sectional differences in value added is predominantly explained by cross-sectional variation in funds size for all classifications.

6.6 Further Implications of Empirical Findings

In Table 3, we found significant growth in fund size for all classifications, although the magnitude of the growth shows large variation across classifications. When comparing the growth in fund size across classifications in Table 4, we find that the average Article 9 fund experienced the by far largest increase in fund size, while Article 6 fund size experienced the least growth between the two periods. This infers that a higher degree of sustainability objective is associated with a larger growth in fund size between the two periods.

For the non-sustainable Article 6 funds, our findings contrast with the findings by Hartzmark and Sussman (2019), studying mutual fund flows as a response to the implementation of the Morningstar Sustainability Rating™. While they find that “low sustainability” funds received significant net fund outflows in the period after the implementation, our results indicate no substantial investor response for Article 6 funds amidst the implementation of the classifications. Coupled with the findings of the substantial capital inflow to green assets, this would suggest that investor demand has not shifted from brown to green funds in the short run following the implementation of the SFDR. Instead, our results indicate that it is mainly new capital on the mutual fund market that has been allocated to sustainable funds. In turn, this

would argue for that increased transparency following the implementation of the SFDR has not prompted a shift in investor demand in the short run, but rather that the classifications helped attracting capital inflows for funds with sustainability objectives.

As suggested by the development of mutual fund flows for the classifications displayed in Figure 2, the capital inflows to Article 9 funds started in the period before the classifications were required to be released. One possible explanation for this result is that some funds announced their classification before the required date, which prompted investors with sustainability preferences to allocate capital to sustainable assets upon becoming informed of their sustainability objective. However, it is also expected, given the pre-existence of sustainability ratings of mutual funds such as the Morningstar Sustainability Rating™, that investors were to some extent already informed about the relative sustainability objective of funds on the market. Thus, the informed investors with a preference for sustainability would be able to allocate their capital accordingly even in the period before funds were classified under the SFDR.

Another explanation for capital inflows to sustainable funds in the pre-period is that investors anticipated an increase in the value of the underlying holdings of sustainable funds following the passing of the regulation. Given that investors anticipated that funds with sustainability constraints would grow considerably following classification, forcing the funds with a limited set of investment opportunities to increase their position in existing holdings, investor demand would increase for sustainable funds in the pre-period. In that case, investors holding sustainable funds would be able to increase the value of their portfolio when high demand for sustainable equities from the sustainable mutual funds drives up the value. It should be noted that this possibility of investor anticipation driving demand for Article 9 funds in the pre-period would imply pecuniary investor motives. In Table 4, we observed that the gross alpha in the pre-period is relatively higher for Article 9 funds compared to Article 8 funds, and relatively lower for Article 6 funds than Article 8 funds. This outperformance would further argue that capital inflows to these relatively more sustainable funds could be driven by pecuniary investor motives.

Being forced to increase the position in existing holdings, which could be the case for large funds and for funds with investment constraints upon receiving large capital inflows, would generate a higher alpha on the pre-existing share of capital in the holdings. However, the new capital allocated to the same holdings would generate a lower alpha because of an increase in the prices driven by the demand for green assets from the sustainable funds. This would explain the post-period deterioration in performance in the post-period for Article 8 and 9 funds that we observed in Table 3. However, this interpretation needs to be confirmed by further research investigating the underlying holdings into which the new capital in Article 8 and 9 funds was invested. Regardless, our finding of capital inflows into Article 8 and 9 funds being followed by a subsequent fall in gross alpha is an argument in favor of the theory proposed by Berk and Green (2004) that funds face diminishing returns to scale. Empirical findings of decreasing returns to scale in active management have also been put forward by, for example, Pástor, Stambaugh and Taylor (2015).

Additionally, on the topic of decreasing returns to scale for mutual funds, we cannot observe this effect in the development for Article 6 funds in Table 3 as the difference in gross alpha is insignificant between the two periods. This result aligns with our expectations given that Article 6 funds have experienced a relatively small increase in fund size, with no substantial capital inflows, which must imply that Article 6 fund size growth is primarily driven by returns. In addition, Article 6 funds have not committed to sustainability-related investment constraints

as opposed to the other two classifications. However, as for the degree of commitment to sustainability objectives, we do not find any significant difference in the deterioration of gross alpha between the Article 8 and 9 funds in Table 4. This implies that our results cannot confirm that a higher degree of self-imposed investment constraints following the SFDR classification has resulted in an accentuated effect of decreasing returns to scale in the short run. This could be a result of these two classifications having more similar investment criteria in practice, generally demanding the same investment opportunities, at least in the short run. Thus, a suggestion for future research, given continued growth at a relatively higher rate following high investor demand for Article 9 funds, would be to investigate the long run impact of the stricter sustainability-related investment constraints.

When examining the development in value added between the two periods in Table 3, our findings in part contradicts those for gross alpha. While Article 9 experienced a decrease in gross alpha between the periods, the substantial increase in fund size in the period after classifications resulted in there being no significant difference in value added. In contrast, for Article 6 funds, their insignificant change in gross alpha between the periods still resulted in an average decrease in value added, indicating that large funds within the classification generate negative gross alpha. Thus, the managerial ability to attract capital for Article 9 funds has on average canceled out the impact of decreasing returns to scale for this classification, and we can also observe in Table 5 that the explanatory power of gross alpha in this change in value added is only 4%. Table 5 provides further insights to our findings on value added, showing that the explanatory power of gross alpha in value added is small and that cross-sectional differences in fund size predominantly explains the cross-sectional differences in value added. In our analysis we find a large cross-sectional variation in fund size along with support for decreasing returns to scale. Therefore, our findings argue in favor of the proposition by Berk and van Binsbergen (2015) of alpha being a poor measure of managerial skill and that the absolute measure value added considering fund size is more appropriate. According to Berk and van Binsbergen (2015), our results in Table 4 would suggest that the average Article 9 fund manager has been the most skilled in navigating the implementation of the SFDR. This follows from Article 9 being the only classification that was able to maintain the total value extracted from the market, as diminishing returns to scale was offset by the ability to attract capital inflows. Although the robustness tests are largely affirmative of our conclusions on value added, they show that both Article 6 and 9 funds have been able to maintain a similar level of value generation both before and after the SFDR implementation.

7 Conclusion

In conclusion, our analysis suggests that the implementation of the Sustainable Finance Disclosure Regulation has had short run implications on the mutual fund market. We find substantial capital inflows to the more sustainable fund classifications, while not observing large capital outflows from the non-sustainable fund classification. Implying that, in the short run, there has not been an evident shift in investor demand from brown to green funds. Instead, new capital on the mutual fund market appears to have been allocated towards green assets. Finding that a higher degree of sustainability commitment relates to a larger growth in fund size, short run capital allocation trends align with the objective behind SFDR. Moreover, we also find that the subsequent deterioration in performance between the period before and after the implementation of the SFDR, as reflected in conventional alpha measures, is associated with decreasing returns to scale for the more sustainable fund classifications. However, we find no short run evidence that the highest degree of sustainability-related investment constraints, represented by Article 9 funds, has experienced a relatively stronger effect of decreasing

returns to scale. Lastly, we find that cross-sectional variation in value added is primarily driven by cross-sectional variation in fund size which, together with our findings relating to decreasing returns to scale, argues in favor of value added being a preferred measure of managerial skill over conventional performance measures. For the most sustainable fund classification, Article 9, the total value extracted from the market by the average fund manager has not significantly changed in the short run following the implementation of the SFDR, as substantial capital inflows are offset by decreasing returns to scale. We propose that further research on the short-term development of the SFDR implementation analyze the underlying holdings of the respective SFDR classifications. This enables confirmation of whether our findings on decreasing returns to scale has been impacted by investment constraints faced by Article 8 and 9 funds. Further, we suggest future research on the long-term implications of the SFDR on the mutual fund market, analyzing if the observed short-term development persists over time and if there are shifts in capital allocation from brown to green funds in the long run.

References

Anderson, A., & Robinson, D.T. (2022). Financial Literacy in the Age of Green Investment. *Review of Finance, 26(6), 1551-1584.*

Berk, J.B., & Green, R.C. (2004). Mutual fund flows and performance in rational markets. *Journal of Political Economy, 112*(6), 1269-1295.

Berk, J. B., & van Binsbergen, J. H. (2015). Measuring skill in the mutual fund industry. *Journal of Financial Economics*, *118*(1), 1–20.

Bioy, H. (2021, November 15). *The Great Reclassification: How SFDR Is Changing Funds.* Morningstar. https://www.morningstar.co.uk/uk/news/216818/the-great-reclassification-how-sfdr-is-changing-funds.aspx

Carhart, M. (1997). On Persistence in Mutual Fund Performance. *The Journal of Finance, 52*(1), 57-82.

Cooper, M. J., Halling, M., & Yang, W. (2021). The Persistence of Fee Dispersion among Mutual Funds. *Review of Finance, 25(2),* 365-402.

Cremers, M., Ferreira, M.A., Matos, P., & Starks, L. (2016). Indexing and active fund management: International evidence. *Journal of Financial Economics, 120*(3), 539-560.

Del Guercio, D., & Tkac, P.A. (2008). Star power: The effect of Morningstar ratings on mutual fund flow. *The Journal of Financial and Quantitative Analysis, 43*(4), 907-936.

Demirci, I., Ferreira, M. A., Matos, P., & Sialm, C. (2022). How Global Is Your Mutual Fund? International Diversification from Multinationals. *The Review of Financial Studies*, *35*(7), 3337–3372.

European Commission. 2020. *EU budget: European Commission welcomes agreement on €1.8 trillion package to help build greener, more digital and more resilient Europe.* https://ec.europa.eu/commission/presscorner/detail/en/IP_20_2073

European Commission. (n.d.). *Sustainability-related disclosure in the financial services sector.* https://finance.ec.europa.eu/sustainable-finance/disclosures/sustainability-related-disclosure-financial-services-sector_en

Fama, E.F., & French, K.R. (1995). Size and book-to-market factors in earnings and returns. *The Journal of Finance, 50*(1), 131-155.

French, K.R. (2024). *Fama/French European 3 Factors.* Data retrieved 20240326 from: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#International

French, K.R. (2024). *European Momentum Factor (Mom).* Data retrieved 20240326 from: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#International

Hartzmark, S.M., & Sussman, A.B. (2019). Do Investors Value Sustainability? A Natural Experiment Examining Ranking and Fund Flows. *The Journal of Finance, 74*(6), 2789-2837.

Ibert, M., Kaniel, R., Van Nieuwerburgh, S., & Vestman, R. (2018). Are Mutual Fund Managers Paid for Investment Skill? *The Review of Financial Studies*, *31*(2), 715–772.

Morningstar, (2024). *Fund Screener*. Data last retrieved 20240329 from: https://www.morningstar.co.uk/uk/screener/fund.aspx#?filtersSelectedValue=%7B%7D&page=1&sortField=legalName&sortOrder=asc

Pástor, L., Stambaugh, R.F., & Taylor, L.A. (2015). Scale and skill in active management. *Journal of Financial Economics*, *116*(1), 23-45.

Pástor, L., Stambaugh, R.F., & Taylor, L.A. (2022). Dissecting green returns. *Journal of Financial Economics*, *146*(2), 403-424.

Refinitiv Eikon. Data on the actively mutual funds were last retrieved: 20240305. Data on the passively managed mutual funds were last retrieved: 20240322.

Riedl, A., & Smeets, P. (2017). Why do investors hold socially responsible mutual funds? *The Journal of Finance*, *72*(6), 2505-2549.

Sirri, E.R., & Tufano, P. (2002). Costly search and mutual fund flows. *The Journal of Finance*, *53*(5), 1589-1622.

The European Commission, 2023, *Answers to questions on the interpretation of Regulation (EU) 2019/2088 (SFDR). https://www.esma.europa.eu/sites/default/files/2023-04/Answers_to_questions_on_the_interpretation_of_Regulation_%28EU%29_20192088.PDF*

The European Parliament and the Council of the European Union, 2019, *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 (Text with EEA relevance)*, Official Journal of the European Union, Document 32019R2088. https://eur-lex.europa.eu/eli/reg/2019/2088/oj

U.S. Bureau of Labor Statistics. (2024). *Consumer Price Index for All Urban Consumers (CPI-U).* Data retrieved: 20240309.