The whole nine yards of climate? New evidence on approaches of climate-oriented mutual funds

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Juris Dobrick, Christian Klein[a] and Lisa Knob[a*]

[a]*Faculty of Economics and Management, University of Kassel, Germany*

**Lisa Knob, Henschelstraße 4, 34127 Kassel, Lisa.Knob@Uni-Kassel.de*

We investigate the characteristics of European climate-oriented mutual funds from two different perspectives. Firstly, we analyze how different climate approaches of climate-oriented mutual funds are associated with specific climate-related metrics. Secondly, we examine the financial performance of the identified approaches. Against this background, we collect the funds' self-declared climate approaches using Refinitiv's fund database. We find heterogeneity among the climate approaches in terms of the relevance of various climate metrics. Furthermore, we find that none of the funds' climate approaches achieve lower risk-adjusted returns. Our findings are relevant for investors, who might have different expectations as to what certain climate approaches should imply in terms of both specific climate metrics as well as financial performance. This study constitutes an important contribution to the literature on climate-oriented investments as most studies fall short to account for the granularity of different climate approaches and climate metrics.

Keywords: Climate indicators; Mutual funds; Sustainable investments; Climate finance

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1. Introduction

According to Andersen (2022), several trillions of US$ in investments are needed by 2050 to achieve the goals of the Paris Agreement. Annual global flows into climate finance reached on average roughly 1.3 trillion US$ in 2021/22 (Buchner et al. 2023). Capital markets should contribute to closing this financing gap (European Commission 2018; Andersen 2022). This raises the question of whether capital market products, such as investment funds, are sufficiently directed toward closing this financing gap. While climate is only one of several sustainability dimensions, it already reveals a wide variety of approaches applied by different funds. Popescu et al. (2021) identify various climate approaches used by climate-oriented funds, including alignment with low-carbon pathways, carbon footprint targets, and exposure metrics. Recent studies show that investors are increasingly interested in sustainable investments (e.g., van Duuren et al. 2016; Riedl and Smeets 2017; Hartzmark and Sussmann 2019), and that especially among private investors, sustainability is strongly associated with ecological issues (Wins and Zwergel 2016), and that those investors prefer climate-related investments over a broader ESG strategy (Thomä et al. 2021; Engler et al. 2023). Nevertheless, ESG investing is still not well-understood by investors (Andrikogiannopoulou et al. 2022; Kaustia and Yu 2021), which underscores the importance of transparent information on how climate approaches are implemented in climate-oriented mutual funds (Popescu et al. 2021). The multitude of approaches underlines the need to disaggregate the broad concept of sustainability into more specific categories (Edmans 2023). In particular, the climate dimension serves as a compelling example of how heterogeneous fund strategies can be, even within a single sustainability theme.

Our research seeks to explore this heterogeneity in greater detail by focusing on the climate approaches of mutual funds. Specifically, to examine whether climate-oriented funds act in accordance with their climate approach, we examine climate metrics that measure a wide variety of climate attributes (Bender et al. 2019; Velte et al. 2020; Popescu et al. 2021; Atta-

Darkua et al. 2022). Thus, climate metrics constitute how the fund addresses its claims, e.g., a fund with the climate approach carbon reduction target invests in firms that have high CO_2 emissions with the goal of reducing the emissions. Against this background, our study addresses two core research questions: (1) How are different climate approaches of climate-oriented funds associated with specific climate metrics? (2) What are the financial implications of the various climate approaches?

These two questions are crucial for several reasons: First, understanding which climate metrics are relevant for specific climate approaches can foster transparency for investors which can positively affect investment decisions toward climate-oriented investments funds. Second, exploring the relationship between climate approaches and financial performance enables investors to make informed investment decisions. Additionally, given the necessity for capital allocation toward achieving the climate goals, addressing these questions can enhance the understanding of how fund flows support climate action and deepen the academic and policy-level dialogue around the integration of climate criteria into investment decision-making. Thereby we focus on climate for different reasons: First, institutional investors are aware that climate change effects have already been materializing (Krueger et al. 2020). Second, climate change is one of the key topics to address sustainability (Atz et al. 2023) and third, climate-related investments are a preferred option by investors (Thomä et al. 2021; Engler et al. 2023). We focus on the mutual fund industry, which represents an important share of global financial markets (Grand View Research 2023).

The literature on climate investing has grown significantly in recent years (e.g., Schramade 2017; Bender et al. 2019; Boermans and Galema 2019; Benz et al. 2020; Popescu et al. 2021). Popescu et al. (2021) provide an overview over methods used by investment funds, including climate methods. Other studies focus on one of the approaches only, e.g., portfolio alignment with climate model projections (Bender et al. 2019), portfolio reweighting toward low carbon (Boermans and Galema 2019), the economic and environmental implications of mutual fund decarbonization (Rohleder et al. 2022), and herding behavior of decarbonization strategies (Benz et al. 2020), or SDG assessment (Schramade 2017). Empirical evidence on the financial returns of sustainable investments shows ambiguous results; however, there is still a lack of dedicated empirical literature specifically addressing the financial performance of climate-focused investments. LaPlante and Watson (2017) study the financial performance of five climate-related indices versus the market. Compared with the standard market benchmarks, four out of five indices exhibit lower carbon intensities and better financial performance than the market. Theoretical considerations suggest that sustainable investments underperform as investors pay a premium for sustainable assets (Fama and French 2007; Pástor et al. 2022). Our research seeks to address the following gaps: First, there is a need for a more granular approach on sustainable finance research (Bender et al. 2019; Edmans 2023). Edmans (2023) emphasizes that research has to be more granular by criticizing the use of ESG ratings to measure a company's climate ambitions, as it is rather the environmental dimension only that is relevant here. Moreover, even within the topic of climate change "*the set of available climate-related metrics is broad and gradually growing*" (Bender et al. 2019). Second, to the best of our knowledge, there are no studies focusing on the relevance of particular climate metrics to adopting different climate approaches of climate-oriented mutual funds. Previous research has applied literature reviews to derive climate approaches (e.g., Bender et al. 2019) or a combination of a literature review and a consultation on practical frameworks (Popescu et al. 2021). Third, the relationship between climate approaches and financial performance remains underexplored, particularly in the context of mutual funds (LaPlante and Watson 2017).

We examine a sample of 622 European climate-oriented mutual funds taking different climate approaches to explore which climate metrics are relevant for each of the different climate approaches. Furthermore, we look at the asset-pricing implications of the each climate approach applying Fama and French (2015) five-factor models. We identify four distinct climate approaches based on self-declared targets, i.e., (1) alignment with the Paris Agreement (*Paris*), (2) carbon reduction target (*Carbon*), (3) alignment with Sustainable Development Goal 13, that is taking Climate Action (*SDG13*), (4) alignment with the EU Taxonomy (*Taxonomy*).[1] To measure the relevance of climate metrics, that is for example, CO_2 emissions, emission reduction target, innovations or an emission policy, for the adoption of the four climate approaches, we apply a four separate multiple logit models (i.e., one model for each climate approach).

In contrast to Amenc et al. (2023), who argue that most green equity strategies exhibit attractive portfolio-level climate metrics while failing to reallocate capital in ways that incentivize companies to contribute to the climate transition, our findings suggest a more differentiated picture. Specifically, we observe that funds with a Paris-aligned approach tend to invest in companies that are on a transition pathway, characterized by the presence of transition plans. Surprisingly, companies included in funds with the *Paris* approach are on average not Paris-aligned themselves. One reason for this could be that there are barriers to the Paris alignment assessments of companies (Popescu et al. 2021; Thomä et al. 2021), such that funds might have trouble identifying Paris-aligned companies. Similarly, funds with the *Carbon* approach tend to invest in companies with higher total CO_2 emissions but provide emission reduction targets. Higher total CO_2 emissions might be one explanation why holdings of the *Carbon* funds have a lower environmental score, given that the environmental score is primarily determined by the total GHG emissions (Refinitiv 2023). Moreover, companies in *Carbon* funds show a higher innovation score, as these companies may use innovations to reduce their CO_2 emissions. According to Boermans and Galema (2019), there are two primary strategies

[1] The approaches are described in more detail in Section 2.

for rebalancing portfolios toward low carbon: (1) sectoral reallocation, i.e., shifting away from carbon-intensive industries, and (2) firm-level exclusion, i.e., divesting from individual companies with high emissions. Our findings suggest the presence of a third strategy: allocating capital to carbon-intensive firms that commit to emission reductions and demonstrate innovative capacity to support such transition. For funds pursuing a Taxonomy-based approach, we also find investments concentrated in emission-intensive sectors. This is consistent with the EU Taxonomy's objective of directing capital toward sectors with the greatest potential for transformation, another form of transition orientation. In contrast, SDG13-oriented funds appear to allocate capital primarily to companies that already offer market environmentally friendly products. These findings highlight the importance of distinguishing between sustainability and transition strategies in climate-oriented mutual funds. They also suggest that some climate approaches, particularly *Paris*, *Carbon* and *Taxonomy* approaches, may indeed contribute to the climate transition by supporting change within high-impact firms, rather than exclusively favoring already green companies.

In a Fama French setup, we analyze the performance and risk structure of our fund sample and construct fund portfolios for each of the four climate approaches. We extract daily return data from Refinitiv Eikon for the 2021 to 2022 period to run linear regressions applying Fama and French (2015) five-factor models. After controlling for market risk, size, value, profitability, investment style, we find no abnormal risk-adjusted returns for any climate approach. Overall, this is in line with our expectations. We find that the risk exposures are quite similar for the portfolios built with funds for the different climate approaches.

This paper shows that there are different climate approaches to address funds' climate claim with various underlying climate metrics. As highlighted by Edmans (2023), it is crucial to adopt a more detailed perspective on the different environmental categories. In response to this, we offer a more granular analysis of climate-oriented funds, addressing the research gap identified by Edmans (2023). Specifically, the paper reveals differences in climate metrics across the various climate approaches, further emphasizing the need for greater granularity. We argue that future studies on climate in the finance context should take these differences into account. Most of the studies on climate impact of funds use different climate metrics. Boermans and Galema (2019) calculate the portfolio carbon footprint based on firm-level CO_2 emissions, and Benz et al. (2020) and Hartzmark and Shue (2021) label firms as green or brown based on environmental scores and emissions, respectively. Despite incorporating CO_2 emissions, Atta-Darkua et al. (2022) consider forward-looking company climate measures such as the development of green technologies, generating green revenues associated with green technologies as well as climate patents. Our findings highlight that future studies should take this multitude of different approaches and metrics into account.

Furthermore, the insights gained are also of central importance for policy makers, investors and companies. Policy makers can encourage fund managers to disclose their approaches towards climate more clearly and to indicate which metrics are used at the holdings level. This information is important for investors but also for companies that can transform themselves accordingly in order to achieve the Paris Agreement and close the finance gap identified by the United Nations (2023).

The remainder of this paper is structured as follows: First, Section 2 provides a detailed theoretical background, including a literature overview. The method and data used are presented in Section 3. In Section 4, we present and discuss our results of the multiple logit models to determine what climate metrics are relevant for each climate approach, as well as of the Fama and French (2015) five-factor models. Finally, this paper ends with Section 5, which contains a concluding summary.

2. Literature review and development of research questions

Recent studies show a high interest of investors in investing sustainably (e.g., van Duuren et al. 2016; Riedl and Smeets 2017; Hartzmark and Sussmann 2019; Gutsche et al. 2023). Motives for sustainable investments stem from personal preferences or investors' perceived moral or ethical obligations leading to an individual perception of sustainability depending on own preferences (Krueger et al. 2020; Gutsche et al. 2023). Engler et al. (2023) find that investors prefer climate-related strategies in investments rather than a broader ESG strategy. According to Thomä et al. (2021), 36% of investors select an approach associated with reducing the exposure to CO_2-intensive investments, whereas only 7% choose an approach related to increasing the exposure to green investments. Consequently, investors have to choose financial products according to their beliefs of what the funds' approaches to climate actually mean with respect to what criteria are decisive in determining which companies are included in the fund taking into account the financial performance of the funds. In this context, recent research highlights that mutual fund investors face limited attention and cognitive capacity, and therefore rely more heavily on salient, easily accessible sources of information (Barber et al. 2005; Hartzmark and Sussmann 2019; Kostovetsky and Warner 2020). Fund prospectuses, which are widely available and written in plain language, thus play a particularly important role in shaping investor perceptions of a fund's ESG profile (Raghunandan and Rajgopal 2022), In the European Union, the Sustainable Finance Disclosure Regulation (SFDR) provides a standardized framework for the disclosure of sustainability-related information (European Commission 2019, 2022). Funds are required to explain their sustainability approach, the objectives pursued, and the indicators used to measure their performance in both pre-contractual documents and periodic reports. For our analysis, we make use of this qualitative information and systematically analyze the SFDR periodic disclosures of a purposive sample of 50

European mutual funds (classified under Articles 8 and 9).[2] Our analysis identifies four distinct climate approaches frequently employed by climate-oriented funds: Paris Alignment, Carbon Reduction Targets, Contribution to SDG 13, and EU Taxonomy Orientation.[3] To embed our findings within the broader academic context, we compare the empirically derived approaches with established classifications of climate investing in the literature.

2.1 The climate metrics relevant to the climate approaches

Previous research on different approaches to climate investing has applied literature reviews to derive climate approaches (e.g., Bender et al. 2019) or a combination of a literature review and a consultation on practical frameworks (Popescu et al. 2021). Popescu et al. (2021) find the following families of methods (i.e., climate approaches) for investment funds: (a) carbon footprints and exposure metrics, (b) alignment with low-carbon pathways (c) ESG ratings, (d) sustainability labels and (e) sustainability-based impact assessment. In contrast, we analyze climate-oriented funds than can be acquired by investors. For the investment funds in our sample, the following climate approaches are being applied that are closely related to the results provided by Popescu et al. (2021): (1) Alignment with the Paris Agreement (*Paris*), (2) carbon reduction target (*Carbon*), (3) alignment with SDG 13 (*SDG13*), (4) alignment with the EU Taxonomy (*Taxonomy*).[4]

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[2] The analysis focuses on core questions derived from the Commission Delegated Regulation (EU) 2022/1288, such as: 'To what extent were the environmental and/or social characteristics promoted by the financial product met? ', 'How did the sustainability indicators perform?' and 'What were the objectives of the sustainable investments made by the product, and how did they contribute to those objectives?

[3] Further details on the qualitative classification procedure and selected disclosure excerpts are available upon request. For the subsequent analysis, we rely on Refinitiv Eikon data, as it provides standardized categories that capture the identified climate approaches.

[4] More detailed descriptions on how we derive the climate approach are provided in Section 3.

We propose that (b) alignment with low-carbon pathways derived by Popescu et al. (2021) corresponds to (1) alignment with the Paris Agreement (*Paris*), given that the Paris Agreement represents a low-carbon pathway (United Nations 2015a). The Paris Agreement was agreed by 197 countries in December 2015 and came into force in November 2016 (United Nations 2015a). It defines goals that serve to combat climate change. These are to limit the global temperature increase to at least 2°C above pre-industrial levels by the end of this century. A fund claiming alignment with the Paris Agreement is likely to incorporate different climate metrics in investment decision making. Bender et al. (2019) illustrate how a portfolio can be tailored to match climate model projections. They demonstrate this with a portfolio calibrated to align with the most conservative climate model projections, aiming to limit cumulative CO_2 emissions to a threshold below the 2°C scenario. According to their analysis funds reduce their exposure to companies with high CO_2 emissions. Such firms already demonstrate minimal carbon footprints by employing energy-efficient technologies and practices. Furthermore, Bender et al. (2019) highlight that one strategy to portfolios matching climate model projects is to minimize exposure to fossil fuels. Based on Bender et al. (2019) we expect funds under the *Paris* approach to more strongly invest in companies operating in low-carbon industries.

The approach (2) carbon reduction target (*Carbon*) refers to the commitment of companies to significantly reduce their greenhouse gas emissions within a defined timeframe. It is therefore related to the method (a) carbon footprints and exposure metrics developed by Popescu et al. (2021). The *Carbon* approach is likely to encompass companies that have set specific, measurable targets for lowering their CO_2 emissions and are actively implementing measures to achieve these targets. To do so, funds under this approach might include companies with high reduction potential. Companies with high reduction potential currently emit high levels of CO_2 emissions and therefore offer significant opportunities for substantial emission reductions. Often, companies are from carbon-intensive industries, such as utilities and consumer staples, where considerable progress can be made in reducing emissions (Aldy et al. 2023). This is in line with the findings of Boermans and Galema (2019), who suggest two strategies for rebalancing portfolios toward low carbon: First, shifting away from sectors with high CO_2 emissions, and second, divesting from individual carbon-intensive companies. The underweighting of carbon-intensive industries seems to be the primary driver of carbon footprint reductions for Dutch pension funds (Boermans and Galema 2019). To measure decarbonization, Boermans and Galema (2019) calculate the portfolio's carbon footprint. Benz et al. (2020) use the companies' carbon emissions to show that investors exhibit herding behavior in the sense of decarbonization, meaning that institutional investors are pursuing similar investment strategies. To account for decarbonization Benz et al. (2020) focus on the environmental score.

Additionally, (e) sustainability-based impact assessment aligns with the example provided by Popescu et al. (2021) of SDG alignment, thus fitting into our categorization under (3) alignment with SDG 13 (*SDG13*). As a result of the United Nations' agenda in 2015, 17 Sustainable Development Goals (SDGs) were introduced (United Nations 2015b). The cross-divisional goals provide a plan for a sustainable development for the planet and humanity. SDG 13 stands for limiting climate change and reducing its impacts. To mitigate greenhouse gas emissions and enhance climate resilience, companies could offer sustainable products, e.g., such that are recyclable, reusable or eco-friendly (GRI et al. 2015). Therefore, we expect funds under the *SDG13* approach favor investments in companies offering such products.

(d) Sustainability labels (Popescu et al. 2021) and (4) alignment with the EU Taxonomy (*Taxonomy*) can be matched, given the taxonomy's function as a sustainability classification system. The EU Taxonomy is intended to redirect capital flows and mitigate the risk of greenwashing (European Commission 2018). The introduction of the EU Taxonomy in June 2020 established a standardized European classification system for defining environmentally sustainable economic activities (Dobránszky-Bartus and Krenchel 2020). With the publication of the EU Taxonomy in June 2020, a uniform European classification system defining environmentally sustainable economic activities has been introduced (Dobránszky-Bartus and Krenchel 2020). At the time of our study, only the first two environmental objectives related to climate are officially adopted. These objectives focus on defining what constitutes a substantial contribution to climate protection under the EU Taxonomy. According to the regulation, an economic activity provides a substantial contribution to climate protection if it helps stabilize greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system. This can be achieved by avoiding or reducing greenhouse gas emissions in line with the long-term temperature goal of the Paris Agreement or enhancing the storage of greenhouse gases through process or product innovations. For activities with no technologically and economically feasible CO_2-free alternatives, they contribute substantially to climate protection if they support the transition to a climate-neutral economy in alignment with the path to limit the temperature rise to 1.5°C above pre-industrial levels. This includes gradually phasing out greenhouse gas emissions. Dumrose et al. (2022) investigate the relationship between the EU Taxonomy and environmental ratings from several rating providers and find a positive relationship between the environmental ratings and EU Taxonomy alignment.

2.2 The financial performance of the climate approaches

As climate change effects have already been materializing, investors are aware that climate change has significant financial implications (Krueger et al. 2020; Aldy et al. 2023). However, investors' expectations regarding the financial performance of climate investments might in reality not be in line with theoretical considerations. Assuming perfect rationality and homogeneous expectations of all actors, in the context of sustainable investments a lower financial performance is to be expected (Fama and French 2007; Pástor et al. 2022). Thus, the financial performance of climate-oriented investments is also expected to be negative for the following reasons. First, as stocks of green companies hedge climate related risks, investors are willing to pay a premium for such assets, leading to a higher price and lower expected returns (Pástor et al. 2022). Second, investors derive utility simply from holding green assets regardless of the risk argument which leads to the same implications regarding financial performance (Fama and French 2007; Pástor et al. 2022). For the above reasons, we expect the financial performance of the investigated climate-oriented mutual funds to be lower, i.e., we expect a negative alpha adjusted for common risk factors. As this argument certainly applies to the climate approaches *Paris, SDG13,* and *Taxonomy,* we argue that it might not fully apply to the *Carbon* approach. While the first three approaches should include companies that can be considered green, the *Carbon* approach does inter alia include firms with high emissions that might not be considered green by some investors who might shun such investments in the sense of the shunned stock hypothesis (Hong and Kacperczyk 2009). Thus, investors might exclude such stocks from their universe of possible investments leading to a lower price and a higher expected return, which would affect the return of the *Carbon* funds likewise, if such stocks are included in the funds. However, as these companies are also ambitious to becoming greener, for example by setting up transition plans or emission reduction targets which might lead to higher ESG scores, we argue that our expectations regarding the financial performance of funds applying the *Carbon* approach is rather ambiguous. Thus, in the context of the *Carbon* approach, the shunned stock argument by Hong and Kacperczyk (2009) might offset the expected negative financial performance as argued by Fama and French (2007) and Pástor et al. (2022), depending on what argument on average outweighs the other for the investigated time period. Empirical findings for either argument are presented for example by Bolton and Kacperczyk (2021) or LaPlante and Watson (2017), although there are only a few studies investigating the financial performance of climate-oriented funds (LaPlante and Watson 2017).

Bolton and Kacperczyk (2021) investigate differences in stock returns for firms with higher emissions and firms with a positive annual growth in emissions. They find that stocks of firms with higher emissions earn higher returns, controlling for size, book-to-market, and other return predictors. LaPlante and Watson (2017) study the financial performance of five climate-related indices versus the market. Compared with the standard market benchmarks, four out of five indices exhibit lower carbon intensities and better performance than the market. Finally, studying a sample of US and European green funds, Silva and Cortez (2016) find that particularly European funds underperform their benchmark. However, they find the performance to be higher in crisis periods which is in line with the argument of Pástor et al. (2022) that such assets hedge climate related risks.

Our research objective is twofold and can be subsumed by the following two research questions.

RQ (1): How are different climate approaches of climate-oriented funds associated with specific climate metrics?

RQ (2): What are the financial implications to the various climate approaches?

3. Methods and data

3.1 Fund selection and data

Our sample consists of European[5] equity mutual funds that implement at least one climate approach as defined in Section 2. Starting from the full universe of European equity funds available on Refinitiv Eikon, we identify those that explicitly disclose at least one of the outlined climate approaches. To do so, we rely on Refinitiv's fund classification system and apply four predefined climate-related categories provided in the database to identify relevant funds. All funds without any climate approach are excluded, resulting in a final sample of 622 climate-oriented mutual funds.[6]

To examine whether climate-oriented funds act in accordance with their stated approaches, we extract data from Refinitiv Eikon to proxy for a set of climate metrics that capture a wide range of climate-related attributes, as outlined in Section 2. In addition, we collect data on standard fund- and firm-level control variables. As most of the climate metrics are aggregated to the fund level via the funds' holdings, we obtain the holdings and their particular weights of each fund in our sample from Refinitiv Eikon, whereby we set the aggregate value at the fund level to missing if less than ten holdings are reported for a fund.[7] In case a fund does not report each holding yielding an aggregated fund weight ($\sum_{i=1}^{N} \omega_i$) of less than 100%, we adjust the remaining holdings' percentual weights such that they sum up to 100%. The average number of holdings for the 622 mutual funds in our sample is 57.86

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[5] Europe comprises all countries of the European Union (EU), plus Iceland, Liechtenstein, Norway, Switzerland and the United Kingdom.

[6] Theoretically, the funds in our sample could adopt multiple climate approaches simultaneously, which could distort our results. Therefore, as a robustness check, we also run the logit regressions and Fama French models in a setting where only funds that adopt one single climate approach are included. The results remain unchanged overall. However, since our sample size becomes very small through this adjustment, we only present the results in which funds can adopt multiple climate approaches. The results of our robustness checks are available upon request.

[7] If a fund holds other mutual funds, then we extract the holdings for these mutual funds as well. We continue with this procedure until all holdings included in a fund are stocks, exclusively.

which on average accounts for 88.93% of the funds' holdings. To proxy for the climate metrics CO_2 emissions and Paris alignment, we use the variables *EmissionTotal* and*, EmissionIntensity*, and *ParisTotal* and *ParisIntensity.* The climate metrics environmental score, eco-friendly products, emission reduction target, emission policy, transition plan, SDG 13 alignment, and innovation are represented by the variables *Escore, EcoDesignProducts, EmissionReductionTarget, EmissionPolicy, TransitionPlan, SDG 13,* and *InnovationScore*, respectively. All these variables are aggregated to the fund level via the holdings level as explained above. Furthermore, we proxy for the climate metric carbon industries by the variable *CarbonIndustries* for which we extract data of each fund's up to ten industries and their specific weights in the fund. We adjust all obtained fund industries such that they fit the ICB sector classification[8] and follow Aldy et al. (2023) to calculate each fund's percentual share of carbon intensive industries, which are the sectors Basic Materials, Energy, Industrials, and Utilities. We use different fund characteristics within our regression setup including total net assets (*TNA*), total expense ratio (*TER*), and the age of the fund, which is defined as the natural logarithm of the number of years since the fund's IPO plus 1 (*Age*) to control for characteristics that might affect the fund strategy.[9] All variables are as of 31st of December of 2022 where applicable. For more detailed descriptions of the variables, please refer to Table I.

[Please insert Table I here]

Subsequently, to address the financial performance of the funds with the different climate approaches, we extract daily return data for each of the funds from Refinitiv Eikon for

[8] The sectors are Basic Materials, Consumer Discretionary, Consumer Staples, Energy, Financials, Healthcare, Industrials, Real state, Technology, Telecommunications and Utilities.

[9] At the fund level, we also controlled for Article 8 and 9 products according to the Sustainable Finance Disclosure Regulation (SFDR). Due to the insignificance of the variable we decided to not include the variable into our models.

the 2021 to 2022 period. Furthermore, we obtain the factors of the Fama and French (2015) five-factor model from Kenneth French's website for the same period.[10]

3.2 Multiple logit models

We apply four separate multiple logit models (i.e., one model for each climate approach) to assess the marginal impact of the climate metrics and our control variables on each of the climate approaches. The parameters are estimated using the maximum likelihood method. More specifically, we estimate the following equation:

$$\begin{aligned} \text{Logit}(\text{Climate approach}_i) = {} & \alpha_0 + \beta_1 \text{TNA}_i + \beta_2 \text{TER}_i + \beta_3 \text{Age}_i + \beta_4 \text{CarbonIndustries}_i \\ & + \beta_5 \text{EmissionTotal}_i + \beta_6 \text{EmissionIntensity}_i + \beta_7 \text{ParisTotal}_i + \beta_8 \text{ParisIntensity}_i \\ & + \beta_9 \text{EScore}_i + \beta_{10} \text{EcoDesignProducts}_i + \beta_{11} \text{EmissionReductionTarget}_i \\ & + \beta_{12} \text{EmissionPolicy}_i + \beta_{13} \text{TransitionPlan}_i + \beta_{14} \text{SDG13}_i + \beta_{15} \text{InnovationScore}_i \end{aligned} \quad (1)$$

where Logit(Climate approach$_i$) is the log of the odds of the ith outcome variable (i.e., the ith climate fund for each climate approach). A value of 1 is assigned to funds adopting climate approach i, while a value of 0 indicates funds that do not adopt climate approach i. The explanatory variables are the variables outlined in Table I. α_0 is the constant of the model. β is the coefficient of each independent variable.[11] To account for unexpected correlations between climate metrics and climate approaches that are not presented in our research framework in Section 2.3, we assess four multiple logit models with identical sets of explanatory variables.

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[10] We thank Kenneth R. French for providing the data on https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[11] In fact, we have reconsidered the setup of the logit models several times. We acknowledge that one might argue that the independent and dependent variables of the models should be swapped, as the fund initially determines its climate approach and then selects the companies that should be included into the fund. However, we argue that the process can also be the opposite. That is, an existing fund is faced with regulatory requirements such as the SFDR and is requested to position itself in a certain way with respect to climate. Put this way, a given fund selects a climate approach that fits its already existing composition. Given that the average fund in our sample is several years old (see Table II), we decided to setup the logit models in the presented way.

3.3 Fama French regression

In a second step, we analyze the performance and risk structure of our fund sample and construct fund portfolios for each of the four climate approaches, i.e., for each "Yes" and "No" portfolio within one climate approach, we select all funds with the corresponding characteristic and add it to the portfolio. This yields a total of four portfolios, for which we extract daily return data from Refinitiv Eikon for the 2021 to 2022 period, which corresponds to a total of 521 trading days.[12] For each of the four constructed portfolios, we run linear regressions applying the Fama and French (2015) five-factor model and estimate the following regression equation.

$$R_{i,d} - Rf = \alpha + \beta_1 MKT_d + \beta_2 SMB_d + \beta_3 HML_d + \beta_4 RMW_d + \beta_5 CMA_d + \varepsilon_{i,d} \quad (2)$$

where i and t in the subscript refer to the i^{th} portfolio and the d^{th} day, respectively. Equation 2 is estimated separately for each of the four portfolios, where the dependent variable is the excess return of each fund portfolio over the risk-free rate. MKT, SMB, HML, RMW, and CMA are market, size, value, profitability and investment factors, respectively. ε is the error term of the model with $\varepsilon \sim N(0,\sigma^2)$.

[12] We are aware that the analysis period is relatively short and that this limits the generalizability of the results. However, a longer time frame could not be used reliably, as the SFDR was introduced in 2021. It is not possible to determine with sufficient certainty whether the funds pursued the same climate approach prior to the observation period.

4. Results and discussion

In this section, we present and discuss the results of the logit and Fama French models from Section 3. In Section 4.1, we initially show descriptive statistics and correlations of the variables of the logit models, whereafter we present and discuss the results of the logit and Fama French models in Sections 4.2 and 4.3, respectively.

4.1 Descriptive statistics and correlations

To draw initial conclusions regarding the relationships between the independent and dependent variables in the multiple logit models, we present descriptive statistics in Table II. We display mean and standard deviation for all independent variables and across all four climate approaches. As we are particularly interested in the differences between the "Yes" (fund applies the approach) and "No" (fund does not apply the approach) options within each climate approach, we show mean and standard deviation separately for both possible outcomes (i.e., "Yes" and "No"). In the row immediately below the indicated climate approaches, N ("Yes") denotes the number of funds (the number of funds' alignments being "Yes") of each approach. Due to missing data regarding the climate approaches as well as the independent variables of the multiple logit models, the number of N differs from the initial number of 622 funds in our sample. According to the mean values shown, we expect the following coefficients for the variables from the multiple logit model of the climate approach *Paris.* Means are decreasing from "No" to "Yes" for *TNA, TER, Age, CarbonIndustries, EmissionTotal, EmissionIntensity, ParisIntensity, EcoDesignProducts.* Thus, we expect negative coefficients for these variables. For *ParisTotal*, *EScore*, *EmissionReductionTarget, EmissionPolicy, TransitionPlan, InnovationScore,* the opposite applies. For the climate approach *Carbon* we have similar expectations. We expect negative coefficients for the variables *TNA, TER, Age, CarbonIndustries, EmissionTotal, EmissionIntensity, ParisIntensity, InnovationScore,* whereas we expect positive coefficients for *EScore, EcoDesignProducts, EmissionReductionTarget,* *EmissionPolicy, TransitionPlan,* and *SDG13*. Regarding the climate approach *SDG13*, negative coefficients are expected for the variable *TNA*, exclusively. Positive coefficients are expected for *TER, Age, CarbonIndustries, EmissionTotal, EmissionIntensity, ParisTotal, ParisIntensity, EScore, EcoDesignProducts, EmissionReductionTarget, SDG13 and InnovationScore.* For the final climate approach *Taxonomy,* negative coefficients are expected for *EcoDesignProducts, EmissionReductionTarget,* and *EmissionPolicy,* whereas positive coefficients are expected for *TNA, TER, Age, CarbonIndustries, EmissionTotal, EmissionIntensity, ParisTotal, EScore, TransitionPlan, SDG13,* and *InnovationScore.*

As correlations between our independent variables may impact our expectations with respect to the signs of the coefficients in the multiple logit models, we present Pearson correlations for all possible pairs of independent variables in Table III. Out of the 105 possible pairs of correlations between the independent variables, 65 pairs are statistically significantly different from zero at least at the 5% level. The bulk of these significant correlations appears to be positive with a few exemptions. The highest correlations of at least .6 are between *SDG13* and *InnovationScore, SDG13* and *EmissionPolicy, EScore* and *EmissionPolicy,* and *SDG13* and *InnovationScore*, with the highest correlation of .81 between *EScore* and *InnovationScore*. This high correlation seems plausible considering that *EScore* is partly determined by *InnovationScore.* All negative correlations that are statistically significant at least at the 5% level are much lower in absolute magnitude compared with the positive correlations. Here, most correlations are between .1 and .3 with the highest negative correlations between the variables *EmissionIntensity* and *EcoDesignProducts* and *EmissionReductionTarget*, respectively. Another negative correlation of similar magnitude is between *CarbonIndustries* and *EmissionReductionTarget,* according to which more carbon intensive industries funds have lower emission reduction targets. As more than a half of all possible pairwise correlations is statistically significant at least at the 5% level, we argue that estimates regarding any signs of coefficients of the independent variables are difficult to make using simple mean comparisons between the “Yes” and “No” options of the climate approaches.

[Please insert Table II and Table III here]

4.2 Logit regression

Table IV shows the results of the logit regressions. The analysis indicates that different climate metrics exhibit varying degrees of relevance for each climate approach. Different climate metrics play significant roles for certain approaches, highlighting the multifaceted nature of climate action strategies.

Regarding the *Paris* approach, we assumed that funds adopting the *Paris* approach should include companies that are more likely Paris-aligned, have lower CO_2 emissions and a lower share of companies operating in carbon intensive industries as well as a higher likelihood of having transition plans on average. The presence of a transition plan (*TransitionPlan*) that considers the companies’ financial strategy shows a positive and highly significant effect, indicating that companies with concrete plans for transitioning to more sustainable practices are more likely to be included by funds with the *Paris* approach. In contrast, Paris alignment (*ParisTotal* nor *ParisIntensity*) is not significant, indicating that the overall companies’ adherence to the Paris Agreement goals do not significantly correlate with the *Paris* approach of the fund. Additionally, funds with the *Paris* approach are smaller (*TNA*) compared to other climate-oriented funds. Our findings are in line with Thomä et al. (2021) who identify various barriers based on a survey conducted among Swiss pension funds and insurance companies such as the need for more in-depth analysis to assess the portfolio’s Paris alignment. One reason for the limited availability of robust data may be that companies invested in are less likely to disclose context-based indicators, such as CO_2 concentration targets Haffar and Searcy (2018). In addition, climate frameworks that aim to align with net-zero pathways, such as the Paris approach, tend to be more complex and difficult to operationalize compared to approaches based on absolute metrics like total emissions (Popescu et al. 2021). The scarcity of Paris-aligned companies could lead to smaller fund sizes and the integration of companies with a transition plan, even if those plans are not necessarily aligned with the Paris Agreement, as a pragmatic approach to include companies on a sustainability path. More mandatory reporting at the company level would help to assess the alignment of the fund with the Paris Agreement (Giesekam et al. 2021). Finally, companies reporting their use of eco-design products (*EcoDesignProducts*) exhibits a negative and significant effect, suggesting that companies with a focus on eco-friendly product design are less likely to be included by funds with the *Paris* approach.

For the *Carbon* approach, our results reveal that a higher emission reduction target (*EmissionReductionTarget*) positively influences the likelihood of companies to be included by funds with the *Carbon* approach. Investments tend to be made in companies with higher total emissions (*EmissionTotal*), whereas emissions intensity (*EmissionIntensity*) is negatively correlated with the dependent variable. This indicates that reduction targets are measured by total values. Nevertheless, the reduction targets are not focused on companies operating in climate-intensive sectors (*CarbonIndustries*), as companies within these sectors would theoretically have a higher reduction potential. Moreover, a lower environmental score (*EScore*) is associated with funds with the *Carbon* approach. This could be due to the fact that the environmental score is primarily determined by the total GHG emissions (Refinitiv 2023). As expected, innovation (*InnovationScore*) exhibits a positive and significant effect, indicating that companies in *Carbon* funds use innovations, for example to reduce CO_2 emissions. Finally, funds with the *Carbon* approach appear to be more cost-intensive (*TER*), which could be due to fund managers needing to engage more actively to achieve the reduction targets.

[Please insert Table IV here]

Considering the *SDG13* approach, the reporting of eco-friendly products (*EcoDesignProducts)* is the only climate metric that is statistically significant. Thus, companies reporting their focus on eco-friendly product designs are more likely to be included by funds that adopt this approach. However, other climate metrics that we expect to be significant such as alignment with SDG 13 (*SDG13*) and an emission policy (*EmissionPolicy*) do not show significant effects. Several findings indicate that SDG investment approaches focusing on SDG 13 are problematic: Bauckloh et al. (2024) demonstrate that SDG ratings vary significantly. Thus, it would be difficult to identify investable companies based on SDG 13. Similarly, according to Schramade (2017), SDG 13 shows a low potential for investment itself because it is rather formulated at the governmental level. Also, at the company level different studies show a risk of SDG-washing (e.g., Beyne 2020; Heras-Saizarbitoria et al. 2022). For instance, Johnsson et al. (2020) propose a specific framework for SDG 13 and underline the importance of framing SDG assessments in a way that discourages SDG-washing.

Finally, for the *Taxonomy* approach, *EmissionIntensity* shows a positive and significant correlation with the dependent variable, suggesting that companies with higher emissions intensity are more likely to be included by funds with the *Taxonomy* approach. Furthermore, companies with a higher *ParisTotal* score are more likely to be included in the fund, whereas for *ParisIntensity* the opposite applies. Both effects are significant at the 10% level. Additionally, an emission policy (*EmissionPolicy*) exhibits a negative and significant impact. These patterns may could be attributed to the fact that Taxonomy-aligned ratios within funds remain relatively low. Although companies have been reporting Taxonomy alignment since 2023, these ratios are still quite modest in many cases (Seidel et al. 2024). Furthermore, funds under the *Taxonomy* approach tend to be older indicating that fund managers may have converted existing funds into Taxonomy-aligned funds. Finally, the higher cost intensity of these funds, as reflected in their Total Expense Ratio (*TER*), may be attributed to the increased effort required for Taxonomy-alignment assessment and the confusion associated with the implementation of Taxonomy-alignment into investment decision making (Norang et al. 2023). This process demands that fund managers account for company-reported data, which is often not yet standardized (Bassen et al. 2022).

4.3 Fama French regression

We present the results of the Fama and French (2015) five-factor regressions with daily return data for the 2021 to 2022 period in Table V. We show intercepts and factor exposures for each climate approach. Overall, we find no difference in risk adjusted performance across all four climate approaches. Thus, for the investigated period investors do not have to sacrifice return when applying a strategy that buys mutual funds with either of the four climate approaches. Our finding contradicts the suggestions of lower returns for green investments made by e.g. Fama and French (2007) and Pástor et al. (2022) as well as our expectations for the climate approaches *Paris*, *SDG13,* and *Taxonomy*. However, as we were unable to derive specific expectations for funds adopting the *Carbon* approach, the results are neither at odds with our expectations, nor do they endorse them. Furthermore, we obtain loadings on the market risk factor which are slightly below 1. This indicates that the four climate approaches are less sensitive to changes in the market return equalling lower exposure to market risk. One explanation could be that sustainable investments are more long-term oriented and therefore more stable compared to non-sustainable investments. Another possible reason is the stronger sectoral concentration. Moreover, we obtain significant and positive loadings on the SMB and RMW factors, respectively, suggesting that all fund strategies tend to overweight smaller stocks and stocks with a robust profitability compared to the overall market. For the HML and CMA factors, we do not find any significant loadings. Overall, the four investigated climate approaches are quite similar regarding their risk exposure.

[Please insert Table V here]

5. Conclusion

In this paper, we investigate the characteristics of European climate-oriented mutual funds from two perspectives: Firstly, by identifying relevant climate metrics for different self-declared climate approaches, and secondly, by examining the financial performance implications of these approaches. We identify four distinct climate approaches: Alignment with the Paris Agreement (*Paris*), carbon reduction target (*Carbon*), alignment with SDG 13 (*SDG13*), and alignment with the EU Taxonomy (*Taxonomy*). Through a comprehensive analysis of 622 European climate-oriented mutual funds, we find that each approach exhibits different sensitivities to the identified climate metrics.

The analysis demonstrates the importance to take a more granular view on the various sustainability categories (Edmans 2023). Our findings highlight that future studies should take this multitude of different approaches and metrics into account. This can be done by studies on climate impact of funds (e.g., Boermans and Galema 2019; Benz et al. 2020; Atta-Darkua et al. 2022; De Angelis et al. 2022). We also contribute to the literature on financial performance of sustainable investments. Our examination of financial performance using Fama and French (2015) five-factor models does not reveal abnormal risk-adjusted returns for any of those climate approaches.

Our analysis reveals some practical implications, e.g., for asset owners. They can benefit from a clearer understanding of the climate approaches adopted by funds and the associated climate metrics, enabling them to make more informed investment decisions aligned with their sustainability objectives. Additionally, these findings have important implications for fund managers, policy makers and companies. Policy makers can use this information to encourage greater transparency and standardization in climate-related disclosures reducing information asymmetries in the market. While the EU's SFDR already requires funds to report on their climate strategies and indicators, recent policy discussions emphasize that current disclosures often lack sufficient granularity, particularly with regard to transition pathways and GHG reduction targets (European Commission 2023; ESMA 2023). These enhancements would help align disclosure practices more closely with investors' need for decision-relevant information. Our insights are also important for companies that are required to disclose climate metrics, so that they can be used by fund managers in developing their investment approaches.

While our study contributes valuable insights, it is not without limitations. The focus on European climate-oriented mutual funds may limit the generalizability of our findings to other regions or types of investment vehicles. Additionally, the use of specific climate metrics and financial performance measures may overlook other important factors that could influence investment decisions. Overall, we examine funds for which their managers indicate the climate approach. Unfortunately, there are also greenwashing risks associated with the self-declaration, as we cannot externally verify whether this approach is truly being pursued.

Looking ahead, future research could explore these limitations by conducting similar analyses on a global scale or examining alternative investment vehicles, such as exchange-traded funds or green bonds. Additionally, further studies could investigate the long-term financial performance of climate-oriented funds or compare it to non-sustainable funds or other sustainable investment approaches that are not climate-oriented.

In summary, our study underscores the importance of understanding the nuances of climate-oriented investments and their implications for both environmental sustainability and financial performance.

Table I

Variable descriptions

This table depicts the descriptions of the variables used in the multiple logit models. For binary variables, observations with missing values (NAs) are excluded from the analysis.

Variable	Description
Climate Approaches	
Paris	The fund's self-declared alignment with the Paris Agreement (Yes=aligned; No=not aligned)
Carbon	The fund's self-declared target of a reduction in carbon emissions (Yes=target; No=no target)
SDG13	The fund's self-declared alignment with SDG 13 (Yes=aligned; No=not aligned)
Taxonomy	The fund's self-declared assessment regarding its alignment with the EU Taxonomy Article 8 or 9 (Yes=aligned; No=not aligned)
Variables at the fund level	
TNA	Total net assets; divided by 1.000
TER	Total expense ratio
Age	The natural logarithm of the number of years since the fund's IPO +1
CarbonIndustries	The fund's percentual share in carbon intensive industries
Variables aggregated from holdings levels	
CarbonIndustries	The fund's percentual share in carbon intensive industries
EmissionTotal	The weighted sum of the holdings' CO_2 equivalent total emissions; divided by 1.000.000
EmissionIntensity	The weighted sum of the holdings' CO_2 equivalent emissions divided by net sales or revenues in US$
ParisTotal	The weighted sum of the categorical variable indicating whether the holdings' GHG scope 1-3 emissions are aligned with the Paris agreement (1 = aligned; 0 = not aligned)
ParisIntensity	The weighted sum of the categorical variable indicating whether the holdings' GHG scope 1-3 emission intensities are aligned with the Paris agreement (1 = aligned; 0 = not aligned)
EScore	The weighted sum of the holdings' Environmental scores
EcoDesignProducts	The weighted sum of the categorical variable indicating whether the holdings report on specific products which are designed for reuse, recycling or the reduction of environmental impacts (1 = reports; 0 = does not report)
EmissionReductionTarget	The weighted sum of the holdings' emission reduction target in percent
EmissionPolicy	The weighted sum of the categorical variable indicating whether the holdings have a policy to improve emission reduction (1 = policy; 0 = no policy)
TransitionPlan	The weighted sum of the categorical variable indicating whether the holdings' transition plans detail how the holdings' efforts are reflected in its financial planning (1 = reflected; 0 = not reflected)
SDG13	The weighted sum of the categorical variable indicating whether the holdings are aligned with SDG 13 (1 = aligned; 0 = not aligned)
InnovationScore	The weighted sum of the holdings' Innovations score

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Table II
Descriptive statistics
This table shows descriptive statistics of the variables used in the multiple logit models. N indicates the number of funds in each climate approach. “Yes” indicates the number of funds that have were assigned a “1” with respect to each climate approach.

	Paris (N =324; “Yes”=135)				*Carbon (N=315; „Yes“=186)*				*SDG13 (N=179; „Yes“=128)*				*Taxonomy (N=612; „Yes“=403)*			
	Yes		No		Yes		No		Yes		No		Yes		No	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TNA	0.47	0.94	0.75	1.45	0.49	0.92	0.79	1.61	0.72	1.60	0.81	1.88	0.57	1.24	0.52	0.96
TER	1.41	0.65	1.58	0.60	1.40	0.66	1.73	0.46	1.48	0.60	1.44	0.70	1.67	0.56	1.38	0.66
Age	1.64	0.87	1.73	1.08	1.61	0.91	1.78	1.11	1.85	1.05	1.83	0.85	2.11	1.07	1.60	0.89
CarbonIndustries	26.59	15.86	33.18	20.82	26.29	16.38	36.32	21.16	32.87	18.85	25.11	20.35	30.52	18.50	24.15	14.30
EmissionTotal	2.43	2.59	3.02	2.60	2.63	2.79	2.95	2.30	2.75	2.54	2.54	2.62	3.29	2.74	2.59	2.52
EmissionIntensity	71.70	76.42	110.47	98.72	69.28	72.16	126.64	90.37	112.40	106.04	98.69	143.82	117.30	136.25	71.87	73.24
ParisTotal	0.24	0.10	0.22	0.10	0.23	0.09	0.23	0.10	0.23	0.09	0.22	0.11	0.24	0.10	0.22	0.09
ParisIntensity	0.47	0.12	0.48	0.12	0.46	0.12	0.49	0.12	0.48	0.12	0.46	0.12	0.47	0.13	0.47	0.11
EScore	69.33	8.67	67.83	7.68	68.81	8.34	67.84	7.89	69.41	8.01	66.55	8.79	69.30	9.01	68.63	8.49
EcoDesignProducts	0.36	0.13	0.37	0.12	0.37	0.14	0.36	0.11	0.41	0.14	0.33	0.13	0.36	0.13	0.37	0.14
Emission ReductionTarget	59.51	7.63	56.76	8.30	59.69	7.80	55.39	8.09	57.29	7.33	55.82	9.06	56.76	8.15	59.49	7.77
EmissionPolicy	0.97	0.05	0.96	0.05	0.97	0.05	0.95	0.05	0.96	0.05	0.95	0.06	0.96	0.05	0.97	0.05
TransitionPlan	0.08	0.06	0.06	0.05	0.08	0.06	0.07	0.05	0.07	0.06	0.07	0.05	0.09	0.07	0.08	0.06
SDG13	0.81	0.13	0.81	0.11	0.81	0.12	0.79	0.12	0.84	0.11	0.78	0.14	0.83	0.12	0.81	0.13
InnovationScore	50.22	10.53	50.20	10.12	49.67	10.05	50.98	10.71	52.20	9.84	47.29	10.78	51.49	11.15	48.91	9.82

Table III

Correlations

This table shows Pearson correlations of the independent variables used in the multiple logit models. For reasons of space, the variables are represented by numbers, whereby the following allocation applies: 1=TNA, 2=TER, 3=Age, 4=CarbonIndustries, 5=EmissionTotal, 6=EmissionIntensity, 7=ParisTotal, 8=ParisIntensity, 9=EScore, 10=EcoDesignProducts, 11=EmissionReductionTarget, 12=PolicyEmissions, 13=TransitionPlan, 14=SDG13, 15=InnovationScore. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.00														
2	-0.03	1.00													
3	0.18***	0.18***	1.00												
4	0.09**	0.14***	-0.02	1.00											
5	0.07*	0.08**	0.09**	0.10**	1.00										
6	0.05	0.10**	-0.03	0.31***	0.55***	1.00									
7	0.07	-0.07*	0.04	0.10**	0.02	0.04	1.00								
8	0.09**	0.09**	-0.05	0.21***	0.31***	0.15***	0.42***	1.00							
9	0.07*	-0.12***	0.12***	0.02	0.33***	-0.03	0.32***	0.22***	1.00						
10	0.05	-0.01	0.10**	0.05	0.10**	-0.20***	0.08*	0.20***	0.45***	1.00					
11	-0.02	-0.07*	0.04	-0.24***	-0.08*	-0.26***	0.02	-0.00	0.22***	0.17***	1.00				
12	0.02	-0.11***	0.17***	-0.04	0.23***	-0.01	0.10**	0.02	0.69***	0.33***	0.16***	1.00			
13	0.05	0.01	0.11***	0.03	0.30***	-0.04	0.23***	0.33***	0.57***	0.21***	0.15***	0.34***	1.00		
14	-0.02	-0.07*	0.18***	0.06	0.28***	0.02	0.18***	0.01	0.71***	0.47***	0.19***	0.60***	0.38***	1.00	
15	0.10**	-0.02	0.15***	0.28***	0.27***	0.05	0.34***	0.19***	0.81***	0.37***	0.05	0.44***	0.44***	0.62***	1.00

Table IV

Average marginal probability effects for multiple logit models

This table shows average marginal probability effects of the parameters of the four separate multiple logit models. The parameters are estimated using the maximum likelihood estimation. Huber-White robust standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Marginal effects.

	Paris	*Carbon*	*SDG13*	*Taxonomy*
TNA	−0.050* (0.030)	−0.027 (0.021)	−0.006 (0.019)	−0.012 (0.015)
TER	−0.053 (0.046)	−0.139*** (0.047)	0.003 (0.055)	0.116*** (0.032)
Age	−0.021 (0.029)	−0.034 (0.028)	−0.023 (0.033)	0.091*** (0.018)
CarbonIndustries	−0.002 (0.002)	−0.001 (0.002)	0.002 (0.002)	0.002 (0.001)
EmissionTotal	0.000 (0.019)	0.050*** (0.017)	−0.020 (0.016)	−0.003 (0.012)
EmissionIntensity	−0.001 (0.001)	−0.002*** (0.001)	0.001 (0.001)	0.001* (0.001)
ParisTotal	0.425 (0.329)	0.204 (0.323)	0.176 (0.389)	0.395* (0.225)
ParisIntensity	−0.116 (0.325)	−0.205 (0.294)	0.178 (0.398)	−0.328* (0.194)
EScore	−0.004 (0.008)	−0.019** (0.008)	−0.009 (0.011)	0.008 (0.006)
EcoDesignProducts	−0.438* (0.258)	−0.020 (0.261)	0.814*** (0.313)	−0.112 (0.164)
EmissionReductionTarget	0.005 (0.004)	0.008** (0.003)	0.006 (0.005)	−0.006** (0.003)
EmissionPolicy	0.699 (0.854)	1.055 (0.882)	−0.163 (1.045)	−1.425*** (0.531)
TransitionPlan	1.813*** (0.598)	0.394 (0.587)	−0.633 (0.650)	0.356 (0.355)
SDG13	−0.498 (0.314)	0.004 (0.314)	0.495 (0.434)	0.275 (0.243)
InnovationScore	0.008 (0.005)	0.011** (0.005)	0.007 (0.007)	−0.003 (0.004)
Constant	−2.150 (3.248)	−1.240 (3.624)	−3.425 (4.335)	4.479** (2.222)
Observations	324	315	179	612
Pseudo R^2	0.112	0.181	0.123	0.140

Table V

Fama French regressions

This table shows the results of the Fama French regressions for the 2021 to 2022 period using daily returns. For each climate approach, we show actor exposures and intercepts for the categories “Yes”, “No”, as well as for the long-short strategy “Yes−No”. β_{MKT}, β_{SMB}, β_{HML}, β_{RMW}, and β_{CMA} are the risk factor exposures with respect to market, size, value, profitability and investment style, respectively. T-statistics based on Newey and West (1986) robust standard errors are presented in parentheses. The intercept term is multiplied by 100 due to space reasons. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}
Paris						
Yes	−0.01 (−0.39)	0.92*** (34.88)	0.53*** (8.07)	0.02 (0.40)	0.25*** (4.30)	−0.13 (−1.54)
No	0.00 (−0.26)	0.85*** (26.50)	0.79*** (10.37)	−0.03 (−0.48)	0.26*** (3.75)	−0.12 (−1.20)
Yes−No	0.00 (−0.15)	0.07*** (7.48)	−0.26*** (−11.77)	0.06** (2.23)	−0.01 (−0.31)	−0.01 (−0.23)
Carbon						
Yes	−0.01 (−0.37)	0.87*** (30.79)	0.62*** (8.99)	−0.01 (−0.19)	0.26*** (4.35)	−0.11 (−1.26)
No	0.00 (−0.23)	0.88*** (27.82)	0.79*** (10.27)	0.00 (0.01)	0.26*** (3.55)	−0.15 (−1.51)
Yes−No	0.00 (−0.32)	−0.01 (−1.09)	−0.17*** (−10.36)	−0.01 (−0.64)	0.00 (0.10)	0.04 (1.49)
SDG13						
Yes	0.00 (−0.26)	0.86*** (26.21)	0.82*** (9.93)	−0.03 (−0.38)	0.28*** (4.23)	−0.11 (−1.08)
No	0.00 (0.13)	0.81*** (26.67)	0.74*** (10.56)	−0.08 (−1.22)	0.28*** (5.00)	−0.13 (−1.38)
Yes−No	−0.01 (−0.90)	0.05*** (5.65)	0.08*** (3.03)	0.05** (2.00)	0.00 (0.06)	0.01 (0.33)
Taxonomy						
Yes	−0.01 (−0.37)	0.82*** (22.99)	0.88*** (10.16)	0.06 (0.80)	0.37*** (5.45)	−0.13 (−1.25)
No	−0.01 (−0.43)	0.87*** (33.79)	0.55*** (8.93)	−0.02 (−0.36)	0.22*** (3.89)	−0.14* (−1.75)
Yes−No	0.00 (−0.14)	−0.05*** (−4.26)	0.33*** (11.1)	0.08*** (2.82)	0.16*** (5.79)	0.01 (0.15)

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