Are the Hedges of Funds Green?

Huan Kuang, Bing Liang, Tianyi Qu, and Mila Getmansky Sherman*

Abstract

Over the past decade, hedge funds have increasingly embraced green investing. We develop a novel return-based measure of fund greenness and find that greener funds earn higher average returns, consistent with capturing a positive green premium, and are associated with lower risks, especially during adverse periods. We further show that performance gains are greatest among directional funds, whereas risk reduction is most pronounced among non-directional funds. We also provide evidence that managers of these funds exhibit superior green investment skills through green stock selection and green factor timing. Finally, investors reward greener hedge funds only when they demonstrate strong performance.

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* Huan Kuang is at Bryant University School of Business; e-mail: hkuang@bryant.edu. Bing Liang is at the Isenberg School of Management, University of Massachusetts Amherst; e-mail: bliang@isenberg.umass.edu. Tianyi Qu is at Baylor University Hankamer School of Business; e-mail: tianyi_qu@baylor.edu. Mila Getmansky Sherman is at Isenberg School of Management, the University of Massachusetts Amherst; e-mail: msherman@isenberg.umass.edu. We thank Yong Chen, Lina Han, Dora Horstman, Jingzhi Huang, Theis Ingerslev Jensen, Nikunj Kapadia, Hossein Kazemi, Xi Liu, Wenting Ma, Marco Macchiavelli, Anya Mkrtchyan, Loriana Pelizzon, Lin Sun, Zheng Sun, Brooke Wang, and seminar participants at Baylor University, George Mason University, Miami University, the University of Iowa, the University of Mannheim, and the University of Massachusetts Amherst for their insightful comments. All errors remain ours.

I. Introduction

As climate change accelerates, financial institutions play an increasingly important role in shifting our economy to a low-carbon future. Professional asset managers are incorporating sustainability considerations into their investment processes.[1] There is a growing literature exploring how financial institutions manage climate risk. Although much has been written about the green investing practices of mutual funds (Ceccarelli, Ramelli, and Wagner (2021), Ceccarelli, Evans, Glossner, Homanen, and Luu (2023), Choi, Gao, Jiang, and Zhang (2023), and Kim and Yoon (2023)), venture capital funds (Barber, Morse, and Yasuda (2021)), and university endowments (Aragon, Jiang, Joenväärä, and Tiu (2025a)), relatively limited research examines how hedge funds, among the most sophisticated investors, react to climate change and incorporate sustainability into their investment processes.

We argue that the hedge fund industry provides an important setting to study green investing for three reasons. First, hedge funds face fewer trading constraints and can use complex strategies with lower transparency and regulatory oversight. This flexibility may allow hedge funds to incorporate green investing into both return generation and risk management, providing downside protection and reducing portfolio drawdowns. Second, unlike "ESG-motivated" investors, hedge funds are profit-oriented arbitrageurs with strong performance incentives.[2] They are more likely to be "ESG-aware" investors who uncover and incorporate sustainability information that is financially relevant but overlooked by other investors (Pedersen, Fitzgibbons, and Pomorski (2021)). Third, hedge funds help improve market efficiency by identifying and

[1] A report from Fortune Business Insights showed that the global ESG investing market size was valued at $39.08 trillion in 2025. Source: https://www.fortunebusinessinsights.com/esg-investing-market-113824

[2] Studies show "ESG-motivated" investors may accept lower financial returns in exchange for nonpecuniary benefits and thus trade off ESG goals against the portfolio Sharpe ratio (Gibson, Glossner, Krueger, Matos, and Steffen (2020), Barber et al. (2021), Kim and Yoon (2023), Aragon et al. (2025a)).

capitalizing on market anomalies (Cao, Lo, Liang, and Petrasek (2018b)). If environmental factors affect firm performance but are not fully reflected in prices (Lindsey, Pruitt, and Schiller (2022)), hedge funds can trade on such mispricing and help price these factors more accurately (Cao, Chen, Goetzmann, and Liang (2018a)).

In this paper, we aim to answer the following questions. First, how does green investing impact hedge fund performance and risk, especially during adverse market conditions? Second, do hedge funds possess specialized green investment skills? Third, is there heterogeneity in the effects of fund greenness across hedge fund investment strategies? Finally, how do investors respond to green hedge funds?

Our study extends the literature on sustainable investing and investment funds by providing new evidence from the hedge fund industry. First, we show that fund-level greenness is associated with higher returns, which contributes to the debate on the financial consequences of sustainable investment. Second, we document that greener hedge funds exhibit lower risk, particularly in adverse states. This finding is consistent with the interpretation that hedge fund greenness relates not only to stronger fund performance but also to a more resilient risk profile. Third, we show that return and risk benefits operate differently across investment strategies. The performance effect is greatest among directional funds, whereas the risk-reduction effect is most pronounced among non-directional funds. Fourth, we identify green investment skill as a distinct dimension of managerial skill and show that green hedge fund managers possess such skill through both green stock selection and green factor timing. Lastly, we propose a new fund-level, return-based measure of green exposure, the green beta, which can be estimated even when holdings data are limited and naturally incorporates both long and short positions.

We start our analysis by introducing green beta, a return-based measure of hedge fund greenness that captures a fund's green exposure. We estimate each hedge fund's green beta by estimating its return exposure to a green factor developed by Pástor, Stambaugh, and Taylor (2022).[3] Next, we study the relation between green beta and fund performance. Our analyses reveal that green beta positively predicts hedge funds' excess returns and seven-factor alphas. The observed outperformance of greener hedge funds underscores the notion that hedge funds can "do well by doing good" (Bénabou and Tirole (2010)).[4] However, we do not find significant outperformance when using green-factor-adjusted alpha, suggesting that the outperformance of greener hedge funds partly reflects compensation for their exposure to the green premium.

In terms of fund risk, we document that greener hedge funds exhibit lower total risk and tail risk. When decomposing total risk into systematic and idiosyncratic components, we find reductions in both risk components. Our result suggests that rather than merely representing exposure to a rewarded factor, greenness in hedge funds may act as a form of climate-related risk mitigation or insurance. Further analysis across strategies reveals meaningful heterogeneity in how green beta relates to fund return and risk. The performance effect is greatest among directional funds, whereas the risk-reduction effect is most pronounced among non-directional funds.

Going beyond unconditional performance and risk, we next test whether green hedge funds exhibit more favorable performance and risk profiles during adverse periods. Specifically, we examine two adverse periods: market downturns and climate-specific stress states. In both settings,

[3] Pástor et al. (2022) construct the green factor as a "zero-cost" long-short factor. They create a portfolio by assigning each stock a weight based on its degree of greenness, with green stocks receiving positive weights and brown stocks receiving negative weights. The green factor is the weighted average market-adjusted portfolio return.

[4] Throughout this paper, we employ the term "green hedge fund(s)" or "green fund(s)" to refer to hedge funds exhibiting higher green beta. This terminology is used interchangeably with the phrase "hedge funds with higher green beta" in order to denote funds that emphasize green investing practices. We employ the term "green hedge fund managers" or "green managers" to refer to the fund managers of green hedge funds.

greener funds display stronger conditional performance and lower risks. This evidence has profound implications for investors seeking portfolio resilience.

We next investigate whether managers of greener hedge funds exhibit green investment skills. We show that managers of these funds demonstrate better stock-picking skills and green factor-timing skills. Finally, we shift our focus to examine whether hedge fund investors recognize and reward green investing practices. We show that greener funds tend to attract greater investor flows, particularly after the 2015 Paris Agreement. However, these incremental flows are concentrated only among funds with strong performance. Additionally, we find that investor flows toward green hedge funds increase after climate news shocks.

Our paper contributes to several strands of literature. First, we complement research on climate change and the investment fund industry. Prior studies examine green investing by mutual funds, venture capital funds, and university endowments, but evidence on hedge funds remains limited (see, e.g., Alok, Kumar, and Wermers (2020), Barber et al. (2021), Ceccarelli et al. (2021), Alekseev, Giglio, Maingi, Selgrad, and Stroebel (2022), and Aragon et al. (2025a)). Focusing on the hedge fund industry allows us to contribute to the broader debate on the financial implications of sustainable investing. Some studies document return–nonpecuniary benefit tradeoffs (Riedl and Smeets (2017), Barber et al. (2021), Gibson, Glossner, Krueger, Matos, and Steffen (2022), Liang, Sun, and Teo (2022), and Kim and Yoon (2023)), whereas others find no performance sacrifice and improved portfolio Sharpe ratios (Pedersen et al. (2021), Lindsey et al. (2022)). We show that fund-level greenness is associated with increased performance. However, our results should be interpreted in light of the green-factor-adjusted alpha findings, which suggest that the outperformance of greener hedge funds partly reflects compensation for their exposure to the green premium.

Second, we contribute to the literature on the risk implications of sustainable investing. Prior research primarily emphasizes the return consequences of sustainable investing, with less attention to its risk effects. The few studies that examine risk often argue that sustainable investment may entail costs, such as reduced diversification and higher return volatility (Ceccarelli et al. (2021), Aragon et al. (2025a)). In contrast, we provide new evidence that greener hedge funds are associated with lower risk, particularly during adverse market conditions. These findings highlight a potential role of sustainable investing in enhancing portfolio resilience.

Third, our study identifies green investment skills as an additional dimension of hedge fund managerial skill. Prior studies document hedge fund managers' skills in areas such as volatility timing, liquidity management, macroeconomic uncertainty, sentiment trading, and political sensitivity (Chen and Liang (2007), Cao, Chen, Liang, and Lo (2013), Bali, Brown, and Caglayan (2014), Chen, Han, and Pan (2021), and Chen, Kumar, Lu, and Singh (2022)), but relatively little is known about their ability to incorporate environmental factors into investment decisions. We provide evidence that managers of greener hedge funds exhibit superior green investment skills in both green stock picking and green factor timing.

Fourth, we introduce a novel return-based measure of hedge fund greenness. Our green beta can be estimated for any fund with observable returns, including funds for which holdings-based measures are difficult to construct. The measure is transparent, uniformly applied, and does not rely on voluntary carbon disclosure. Because it is estimated at the individual fund level, it avoids the noise in firm-level metrics that aggregate multiple strategies. It also captures both long and short positions, providing a more comprehensive assessment of hedge fund green exposure.

Our paper is closely related to the contemporaneous study by Aragon, Jiang, Joenväärä, and Tiu (2025b), and both studies address an underexplored area in the literature on hedge fund green investing. Our study complements their work by examining the broader performance and risk implications of green investing. In addition to documenting a positive relation between fund greenness and performance, we show that greener hedge funds have lower risk, particularly during market downturns and periods of heightened climate-policy uncertainty. We also find that the benefits of green investing vary across fund investment strategies. Finally, we identify both green stock selection and green factor timing as important sources of green investment skills. Taken together, the two studies provide consistent and complementary evidence on hedge fund green investing and highlight the important role hedge funds play in this area.

The paper is organized as follows: Section II describes the data and outlines the methodology for measuring hedge fund greenness. Section III presents the empirical results, followed by the robustness analysis in Section IV. Finally, Section V concludes the study.

II. Data and Methodology

In this section, we summarize the datasets used in our empirical analysis and introduce a novel method for measuring a hedge fund's greenness, which enables us to assess a hedge fund's exposure to green stocks at the individual fund level.

A. Data and Sample Construction

We construct a comprehensive hedge fund sample consisting of both live and defunct hedge funds from TASS, HFR, and Morningstar CISDM. The merged dataset has a total of 1,963 hedge funds, of which 890 are live funds and 1,073 are dead (defunct) funds. We limit the sample to fund-month observations with at least $1 million in assets under management (AUM), and our final sample contains 66,841 fund-month observations spanning January 2012 to December 2021.[5]

[5] We also re-estimate our main analyses using a more stringent sample restriction that requires fund-month observations to have at least $10 million in AUM. The results remain consistent and are reported in Table A11 of the Online Appendix.

In addition to net-of-fee returns and AUM, we obtain a broad range of fund characteristics, including management fee, incentive fee, lock-up period, leverage, high water mark, investment strategies, inception date, fund location, and fund manager information. We categorize funds into twelve different investment strategies following Liang et al. (2022).

Commercial hedge fund databases suffer from two potential biases: backfilling bias and incubation bias.[6] To reduce the backfilling bias, we follow Liang et al. (2022) and include only hedge fund returns that were reported after the fund's listing date in the database. In cases where databases do not provide information on listing dates, we employ Jorion and Schwarz (2019)'s algorithm to infer the listing dates. To eliminate the incubation bias, we follow Liang et al. (2022) and exclude the first 24 months of return data.[7]

For other datasets, hedge fund holdings data are from the Thomson Reuters CDA/Spectrum Institutional (13F) Holdings Database. Stock return data are from the Center for Research in Security Prices (CRSP), and the firms' financial data are from Compustat. The risk factors for the Fama–French (1993) three-factor model, the Carhart (1997) four-factor model, and the Fama–French (2015) five-factor model are from Kenneth French's data library. Company-level carbon risk scores are from Sustainalytics, which is a leading company in ESG research and ratings. The carbon risk score takes values between 0 and 100, where lower scores correspond to firms with lower carbon risk (green) and higher scores correspond to firms with greater carbon risk (brown). Firm green innovation data are from the United States Patent and Trademark Office (USPTO) Bulk Data Storage System.[8]

[6] Backfill bias occurs when funds retroactively report strong pre-listing returns to attract capital, leading to performance overestimation (Liang (2000), Fung and Hsieh (2009), Bhardwaj, Gorton, and Rouwenhorst (2014)). Incubation bias comes from the tendency of hedge fund managers to leverage prior successful investment strategies during the incubation period.

[7] We first remove the first 24 months of returns to address incubation bias. Then, if there are still returns that were reported before the fund's listing date in the database, we remove them to address backfill bias.

[8] Please refer to Kuang and Liang (2024) on how we identify green innovations.

B. Measure of Hedge Fund Green Beta

We construct a novel measure to capture a hedge fund's exposure to green assets at the individual fund level and refer to this measure as green beta. Specifically, we estimate fund green beta using the following regression model:

(1) $r_{i,t} = \alpha_i + \beta_g f_{green,t} + \sum_{j=1}^{J} \beta_j f_{j,t} + \varepsilon_{i,t}$

where $r_{i,t}$ is the return of fund i in month t over the risk-free rate. $f_{green,t}$ is the green factor proposed in Pástor et al. (2022). β_g is the green beta that measures fund i's exposure to green assets. A higher (lower) green beta indicates that the fund is greener (browner) due to its greater (smaller) exposure to the green factor. $f_{j,t}$ denotes the seven factors from Fung and Hsieh's (2004) seven-factor model. In the main regression analysis, we use 24-month rolling windows to estimate the coefficients. The results are consistent if we change the rolling window to 12 months or 18 months.

One concern is that a hedge fund's exposure to the green factor may inherently entail exposure to the market factor, implying that the green beta could partially capture the same information as the market beta. To address this issue, we investigate the correlation between the green beta and each of the betas in the seven-factor model. As demonstrated in Table A1 of the Online Appendix, the correlation between green beta and market beta is positive, yet the magnitude remains relatively small at 0.16. This indicates that, although some overlap exists between the information contained in the green factor and market factor, the extent to which green beta and market beta pick up similar information remains minimal. The correlations between the green beta and other betas are even smaller. As a result, the low correlations between green beta and all other betas provide no evidence that the green beta captures exposure to other risk factors.

An alternative approach to assessing a hedge fund's exposure to the green factor is to calculate the value-weighted average portfolio carbon risk score using the stock holdings data of hedge fund firms (Liang et al. (2022)). We argue that our return-based green beta methodology offers several advantages over this alternative measure. First, the cross-sectional coverage of our measure surpasses that of the hedge fund firm-level carbon risk measure. Our method enables the estimation of sensitivity toward a green factor for any hedge fund with observable returns. Consequently, our approach allows for the calculation of green betas for hedge funds that lack other carbon-related measures, as well as for strategies for which constructing such metrics is inherently challenging. The estimation process is transparent and uniform across all hedge funds and does not rely on the voluntary disclosure of carbon-related information. Second, the green beta is computed at the individual fund level, whereas the carbon risk measure is determined at the hedge fund management firm level, which is prone to higher noise as one firm may comprise multiple funds with varying strategies. Our green beta measure can be directly employed to analyze the relationship between a hedge fund's green exposure and its performance, risk, and investor flows. Third, hedge funds may pursue decarbonization strategies by short-selling brown stocks, which is not reflected in the holdings-based measures. Our return-based approach overcomes this issue by accounting for both long and short positions and incorporating leverage, thus capturing a more comprehensive representation of the hedge fund's efforts toward decarbonization. Nonetheless, as a robustness test, we calculate a hedge fund holdings-based carbon risk measure and substitute it for green beta in our main analysis, and the main results are consistent.

C. Summary Statistics

Table 1 presents the summary statistics of the variables used in our baseline regression. For all hedge funds in our sample, the mean of AUM is $396.773 million, the average monthly return is 0.564%, while the monthly seven-factor alpha is 0.144%. In terms of risk, the average total risk is 2.977%, whereas the tail risk averages 5.313% per month. The average monthly fund flow is 0.001%, but the variation among funds is substantial. The average age is 10.6 years. The average hedge fund green beta in our sample is -0.003, while the median is 0.015. These findings suggest that, on average, hedge funds exhibit relatively low exposure to green stocks. However, the green beta measure has a standard deviation of 1.109, indicating a considerable variation in the degree of exposure to green assets across different funds.

[insert Table 1 about here]

Table 2 reports the distribution of green beta among diverse hedge fund investment strategies. Long-only hedge funds exhibit the highest average green beta (0.678), followed by multi-strategy and global macro. In contrast, hedge fund strategies such as short bias, emerging markets, and sector-focused funds display the lowest green beta. These strategies may face greater challenges in integrating ESG considerations into their investment processes, as their investment objectives and portfolio construction approaches differ substantially from those of traditional long-only equity funds.

[insert Table 2 about here]

D. Hedge Fund Holdings and Trading toward Green Assets

We also report descriptive evidence on hedge fund allocations and trading patterns across green and brown industries using 13F holdings data. Each year, we sort industries into terciles based on their industry-average carbon risk scores. Industries in the lowest tercile are classified as green, while those in the highest tercile are classified as brown (we omit the middle tercile for brevity). Figure 1A shows that, over our sample period, the average portfolio weight in green industries increases from 33% to 42%, while the weight in brown industries declines from 20% to 14%.

Next, we employ the same sorting procedure and report hedge funds' quarterly trading patterns. Figure 1B shows that hedge funds' net purchases are generally higher in green industries, with notable peaks in 2015 and again in 2020 around the COVID period. At the same time, hedge funds do not fully exit brown industries. They maintain net purchases of approximately 10% of high-carbon companies each quarter. This pattern aligns with a positive-screening mechanism, in which hedge funds decarbonize their portfolios by increasing holdings of green stocks while maintaining a presence in brown industries.

Lastly, we describe hedge funds' trading behavior at the stock level. Building on the industry greenness classification, we further sort firms within each industry into terciles based on firm-level carbon risk. This two-way double sort assigns each firm an industry label and a within-industry greenness rank. Figures 1C and 1D plot hedge funds' net quarterly trading for each stock category as a percentage of prior-quarter holdings, separately for green-industry and brown-industry stocks. The figures show an asymmetric pattern. Within green industries, hedge funds tilt their trading toward the greenest firms, whereas within brown industries, they show little differentiation across firms.

[insert Figure 1 about here]

III. Empirical Results

A. Hedge Fund Greenness and Fund Performance

In this section, we examine how hedge funds' degree of greenness, measured by the fund green beta introduced in Section II.B, affects hedge fund performance.

We start with the univariate analysis. Each month, funds are sorted into quintiles based on their green beta. We then evaluate the portfolio performance over the next month for funds in each quintile. We measure fund performance in two ways: fund excess return and Fung and Hsieh seven-factor alphas using a rolling 24-month window. Panel A of Table 3 reports the results. We observe a monotonic increase in hedge fund performance with the fund's green beta. This initial evidence suggests that high-green-beta funds outperform their low-green-beta counterparts.

The sorting results may be driven by other factors that explain hedge fund returns. To alleviate this concern, we estimate the following regression model:

(2) $$Fund\ performance_{i,t+1} = \beta_0 + \beta_1 \times Green\ beta_{i,t} + \beta_2 \times Log(size)_{i,t} + \beta_3 \times Age_{i,t} + \beta_4 \times Lockup\ _{i,t} + \beta_5 \times Management\ fee_{i,t} + \beta_6 \times\ Incentive\ fee_{i,t} + \beta_7 \times High\ water\ mark_{i,t} + \beta_8 \times Leveraged_{i,t} + \varepsilon_{i,t+1}$$

where *Fund performance* represents hedge fund excess return or the seven-factor alpha in the next month. *Green beta* is estimated from equation (1). The specification controls for standard fund characteristics. Size refers to a fund's AUM, measured in millions of USD. Fund age measures years since the fund's inception date. The lock-up period is measured in months. Both management and incentive fees are reported as percentages. High water mark is a dummy variable that takes the value of one if the hedge fund uses a high water mark and zero otherwise. Leveraged is a dummy variable that equals one if the hedge fund uses leverage, and zero otherwise. We include strategy and time fixed effects and cluster standard errors by fund.

Panel B of Table 3 reports regression results. Across specifications, the coefficient on green beta is positive and statistically significant. Specifically, a one-standard-deviation increase in fund green beta is associated with a 0.985% per annum (=0.074%×1.109×12) increase in fund alpha and a 1.624% (=0.122%×1.109×12) per annum increase in the excess return. Both coefficient estimates are significant at the 1% level. Overall, this finding provides empirical evidence that a hedge fund's green beta positively predicts the fund's performance.

As a robustness test, we re-estimate the performance regression using a green-factor-adjusted alpha. We augment the Fung–Hsieh seven-factor model by adding the Pástor et al. (2022) green factor when estimating fund alphas. [9] The coefficient on green beta becomes economically small and statistically insignificant, suggesting that part of the baseline outperformance reflect compensation for bearing green-factor exposure. Our outperformance results should be interpreted in light of the green-factor-adjusted alpha findings.

[insert Table 3 about here]

B. Hedge Fund Greenness and Fund Risk

An important and previously unexplored question in the literature is whether a hedge fund's green beta is associated with the fund's risk profile. We hypothesize that hedge fund greenness is linked to a more resilient risk profile. This conjecture is motivated by studies showing that stocks with lower carbon risk have lower total risk (Engle, Giglio, Kelly, Lee, and Stroebel (2020), Bolton and Kacperczyk (2021)) and lower tail risk (Ilhan, Sautner, and Vilkov (2021)). At the same time, green portfolios may be more concentrated, which can weaken diversification benefits and increase return covariance (Ceccarelli et al. (2021)). Thus, the relation between green beta and hedge fund risk is ambiguous. Hedge funds provide a useful setting to examine this relation because their flexible strategies may shape the relation between green exposure and risk in ways that differ from traditional long-only portfolios.

To examine the relation between hedge fund green beta and fund risk, we consider four risk outcomes. Total risk is measured as the standard deviation of the fund's monthly excess returns over a rolling window of the prior 24 months. We further decompose total risk into its systematic and idiosyncratic components. Idiosyncratic risk is measured as the standard deviation of the

[9] To avoid a mechanical relation between the estimated green beta and the estimated alpha, we use non-overlapping windows to estimate beta and alpha in this robustness test.

residuals from the fund's factor model used to estimate alpha. Systematic risk is then measured as the component of total risk attributable to common factors, computed from the variance decomposition between total and idiosyncratic risk.[10] Finally, tail risk is measured as the fund's two-year 95% value-at-risk (VaR). We estimate the following regression model:

(3) $Fund\ risk_{i,t+1} = \beta_0 + \beta_1 \times Green\ beta_{i,t} + \sum \beta_n \times Fund\ Controls_{n,t} + \varepsilon_{i,t+1}$

where *Fund risk* represents total risk, systematic risk, idiosyncratic risk, or tail risk (VaR), as defined above. *Green beta* is estimated from equation (1). The specification includes the same set of control variables for fund characteristics as in equation (2). We include strategy and time fixed effects and cluster standard errors by fund.

Table 4 reports the regression results. Across all specifications, the coefficient on green beta is negative, indicating that greener hedge funds exhibit lower risk after controlling for observable fund characteristics and fixed effects. Specifically, a one-standard-deviation increase in fund green beta is associated with a monthly decrease of 0.083% in total risk, 0.069% in systematic risk, 0.074% in idiosyncratic risk, and 0.134% in tail risk (VaR).[11] The economic magnitude is greatest for tail risk, consistent with climate risk being especially concentrated in the left tail.[12] At the same time, we find that greener hedge funds exhibit significantly lower total risk. When we decompose total risk into systematic and idiosyncratic components, we find that both channels contribute to the overall risk reduction. Among the other control variables, fund size is

[10] We decompose fund return variance into systematic and idiosyncratic components. For each fund, systematic risk is computed from the variance decomposition as $\sigma_{sys} = \sqrt{\sigma_{total}^2 - \sigma_{idio}^2}$, where σ_{total} is the standard deviation of monthly fund returns and σ_{idio} is the standard deviation of residuals from the factor model used to estimate alpha, both computed over the same 24-month rolling window.

[11] We multiply the coefficients by the standard deviation of fund green beta. For example, for total risk, we calculate the monthly decrease as 0.083% (=0.075% × 1.109). The same calculation applies to the other risk measures.

[12] Ilhan et al. (2021) emphasize that carbon-related exposures matter most when markets price climate risk in "bad" states, and they document evidence consistent with investors demanding compensation for carbon tail risk.

negatively correlated with all types of risk, while the lock-up period is positively related to all risk measures.

To summarize, this section provides empirical evidence that a hedge fund's green beta is associated not only with improved fund performance but also with lower fund risk. The risk reduction shows up in overall volatility and downside risk, and reflects declines in both systematic and idiosyncratic components. Overall, the evidence suggests that green exposure is associated with a more favorable risk–return profile.

[insert Table 4 about here]

C. Hedge Fund Greenness and Conditional Performance and Risk

Moving beyond unconditional performance and risk, we next test whether greener hedge funds exhibit more favorable conditional performance and risk profiles during adverse periods. Prior research shows that socially favorable assets may provide resilience when markets face broad or climate-related stress (Albuquerque, Koskinen, Yang, and Zhang (2020), Pástor and Vorsatz (2020), and Pástor et al. (2022)). If green characteristics capture a form of climate risk hedging or reflect managers' ability to anticipate regulatory and transition risk, their advantages should be most pronounced in adverse market states rather than in normal times. Motivated by this intuition, we examine whether greener hedge funds exhibit stronger conditional performance and lower risk across two types of adverse states: market downturns and climate-related stress periods.

1. Market Downturns

First, we test whether greener hedge funds perform better in market downturns and exhibit more favorable conditional risk outcomes. Following Baur and Lucey (2010) and Baur and McDermott (2010), we define market crash months as months when the S&P 500 return falls within the bottom 1% of its distribution over the prior 30 years.[13] As a robustness check, we alternatively define market downturns using NBER recession months, and our results are consistent.[14] We modify equations (2) and (3) and estimate the following regression:

(4) $Performance\ /\ risk_{i,t+1} = \beta_0 + \beta_1 \times Green\ beta_{i,t} + \beta_2 \times Green\ beta_{i,t} \times Market\ crash_t + \sum \beta_n \times Fund\ Controls_{n,t} + \varepsilon_{i,t+1}$

where the dependent variable is either the fund performance measure used in equation (2) or the fund risk measure used in equation (3). *Green beta* is estimated from equation (1). *Market crash* is a dummy variable that equals one in months classified as market crash months (as defined above) and zero otherwise. The specification includes the same set of control variables for fund characteristics as in equation (2). We include strategy and time fixed effects and cluster standard errors by fund. The standalone *Market crash* variable is absorbed with time fixed effects included.

Panel A of Table 5 reports the results. Columns (1) and (2) focus on performance. The interaction between *Green beta* and *Market crash* is positive and statistically significant, suggesting that greener funds perform better during market downturns. On an annualized basis, a one-standard-deviation increase in fund green beta during market crash months translates into 2.502% (=0.188%×1.109×12) higher excess returns and 1.464% (=0.110%×1.109×12) higher alpha, implying a meaningful improvement in conditional performance. The coefficient on fund green beta remains positive across specifications, consistent with greener funds performing better on average, while the interaction shows that this relation strengthens specifically in bad states.

Columns (3) to (6) report the risk results. The interaction is negative and statistically significant for systematic risk and tail risk, indicating that greener funds are associated with lower

[13] We use a 30-year window to calibrate the crash threshold because it provides a long historical benchmark that covers multiple market cycles (1992-2021), and it avoids defining market crash using information only from our sample period.

[14] We report the results in Panel A of Table A3 of the Online Appendix.

market-wide exposure and downside risk. Economically, in crash months, a one-standard-deviation increase in fund green beta is associated with an additional 0.199% reduction in systematic risk and an additional 0.281% reduction in tail risk.[15] Relative to the sample means of these variables, these effects correspond to reductions of approximately 8.6% and 5.3%, respectively.[16] This pattern suggests that, during market downturns, the association between green beta and risk reduction may operate through the systematic and downside-risk channels more directly. One possible interpretation is that market stress primarily amplifies aggregate and tail-related risk, and greener funds appear relatively better insulated. However, idiosyncratic risk reflects fund-specific shocks that are not directly linked to market-wide conditions, which limits the scope for green exposure to provide hedging benefits along this dimension. Similarly, total risk also incorporates idiosyncratic volatility, thereby attenuating the overall effect.

2. Climate-Related Stress Periods

Second, we examine whether green exposure is associated with more favorable performance and risk outcomes during climate-related stress states. Climate policy has become more uncertain in recent years as governments adjust their climate agendas and political priorities shift. Gavriilidis, Känzig, Raghavan, and Stock (2026) develop a Climate Policy Uncertainty (CPU) index to capture uncertainty related to climate policy. Using this index, we construct a climate-stress dummy variable to identify periods of high climate policy uncertainty by sorting the CPU index into quintiles over its 30-year distribution and defining high-CPU months as those in the top quintile.[17] Specifically, *High CPU* is a dummy variable that equals one in months with high climate

[15] We multiply the coefficients by the standard deviation of fund green beta. For example, for systematic risk, we calculate the monthly decrease as 0.199% (=0.179% × 1.109). The same calculation applies to the other risk measures.
[16] To quantify the percentage reduction relative to the mean level of systematic risk, we divide 0.199% by the mean systematic risk value of 2.301%, yielding a reduction of 8.6%. The same calculation applies to tail risk.
[17] We also capture climate-related stress periods using a climate sentiment measure constructed from climate news coverage. Using this alternative specification, we obtain qualitatively similar, though somewhat weaker, results (see Panel B of Table A3 in the Online Appendix).

policy uncertainty and zero otherwise. Next, we rerun equation (4) and replace the *Market crash* dummy variable with the *High CPU* dummy variable.

Panel B of Table 5 reports the results. Columns (1) and (2) focus on fund performance and show that the interaction between *Green beta* and *High CPU* is positive and statistically significant, indicating that greener funds achieve stronger conditional performance during periods of elevated climate policy uncertainty. On an annualized basis, these estimates translate into approximately 2.129% higher excess returns and 0.905% higher alpha. Columns (3) to (6) focus on fund risk and show that the interaction is negative and statistically significant across all four risk measures. Economically, in high-CPU months, a one-standard-deviation increase in fund green beta is associated with an additional reduction of 0.324% in total risk, 0.240% in systematic risk, 0.197% in idiosyncratic risk, and 0.217% in tail risk. Relative to the sample means of these variables, these effects correspond to reductions of approximately 10.9%, 10.4%, 11.3%, and 4.1%, respectively. The economic magnitudes suggest meaningful association between green exposure and risk reduction. The results also show that the relation between green exposure and lower risk extends beyond a single risk component during periods of elevated climate policy uncertainty. While market crashes primarily amplify systematic and downside risk, climate policy uncertainty constitutes a persistent, policy-driven shock that influences both market-wide and fund-specific risk. Consistent with this view, exposure to greener firms appears to be associated with lower risk across multiple dimensions during high-CPU periods.

Overall, the evidence suggests that greener hedge funds exhibit greater portfolio resilience in adverse states, achieving superior relative performance and lower risk during market downturns and climate-related stress periods.[18]

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[18] We re-estimate the main analyses in Tables 3, 4, and 5 using a more conservative $10 million AUM cutoff based on monthly AUM over the sample period. We report the corresponding performance results in Table A11, the risk

[insert Table 5 about here]

D. Hedge Fund Greenness and Green Investment Skills

Having established that greener hedge funds are associated with better performance and lower risk, we next investigate whether managers of these funds exhibit green investment skills. In this section, we explore two potential channels underlying the performance of green hedge funds: green stock-picking skills and green factor-timing skills. These mechanisms are not mutually exclusive.

1. Green Stock-Picking Skills

We begin by assessing whether managers of greener funds exhibit superior general stock-picking skills. To test this conjecture, we follow Kacperczyk, Nieuwerburgh, and Veldkamp (2014) and utilize hedge fund holdings data from hedge funds' 13F filings. Specifically, we measure hedge fund managers' general stock-picking skills as follows:

(5) $Stock\ picking\ skill_{j,t} = \sum_{k=1}^{N^j} \left(w_{k,t}^{j} - w_{k,t}^{m}\right)\left(R_{t+1}^{k} - \beta_{k,t} R_{t+1}^{m}\right)$

where $w_{k,t}^{j}$ is hedge fund management firm *j*'s portfolio weight in stock *k* at the start of quarter *t* and $w_{k,t}^{m}$ is the market weight in stock *k*. The covariance of stock *k*'s return, R^k, with the market return, R^m, divided by the variance of the market return is β_k. *N* is the number of companies in the portfolio. A fund with a better stock-picking ability holds a larger fraction of a company during periods when that company's realized stock return is high.

Since stock-picking skills are captured at the hedge fund management firm level, we aggregate individual fund green beta and other control variables to the hedge fund management firm level using both equal-weighted and value-weighted methods. We then regress the stock-

results in Table A12, and the adverse-state performance and risk results in Table A13 of the Online Appendix. The findings remain consistent.

picking skill variable on the aggregated green beta of hedge fund management firms and other firm-level characteristics using the following model:

(6) $Stock\ picking\ skill_{j,t+1} = \beta_0 + \beta_1 \times Green\ beta_{j,t} + \sum \beta_n \times Firm\ Controls_{n,t} + \varepsilon_{j,t+1}$

where *Stock-picking skill* is estimated from the regression equation (5), and *Green beta* is estimated from the regression equation (1). The coefficient β_1 captures the relation between a fund's green beta and the fund managers' stock-picking skills. A positive and statistically significant β_1 indicates that a hedge fund with a higher green beta demonstrates better stock-picking skills. We include strategy and time fixed effects and cluster standard errors by hedge fund management firm.[19] Panel A of Table 6 reports the regression results. The coefficient of the variable of interest is positive and statistically significant across all specifications, indicating that higher green beta is associated with stronger stock-picking ability.

Next, we explore whether these managers apply their stock-picking skills to identify better green stocks. Specifically, we examine whether the managers can identify companies possessing sustainability-related information not yet discovered by the market. We analyze this information across two dimensions: carbon risk reduction and green innovation. We estimate the following regression model:

(7) $\Delta Firm\ Sustainability\ Potential_{k,n} = \beta_0 + \beta_1 \times Overweight_{k,t} + \beta_2 \times BM\ ratio_{k,t} +$

$\beta_3 \times Return_{k,t} + \beta_4 \times Log(size)_{k,t} + \beta_5 \times ROA_{k,t} + \varepsilon_{k,t}$

where $\Delta Firm\ Sustainability\ Potential_{k,n}$ represents the change in company *k's* carbon risk score or change in the number of green patents the company issues *n* years from year *t*. We let *n* take the values of 1, 3, and 5 years. $Overweight_{k,t}$ is defined as the difference between firm *k*'s

[19] We infer a hedge fund management firm's strategy based on the strategy of its largest fund if the firm manages multiple funds.

weight in the aggregate portfolio of green hedge funds and its weight in the overall market portfolio. Green hedge funds are defined as funds in the top quintile of green beta. A positive value of $Overweight_{k,t}$ indicates that green hedge funds allocate disproportionately more to firm k than the market does, while a negative value indicates underweighting. We control for a company's book-to-market ratio, return, log of asset size, and return-on-assets ratio. We also control for year and industry fixed effects and cluster standard errors at the company level.

Panel B of Table 6 tabulates the regression results. We observe that green hedge funds are inclined to favor companies poised for future carbon risk reduction or an increase in green innovation. Specifically, a 10% overweight by green hedge funds is associated with a reduction in carbon risk by 48.85% in the short term (3 years) and 63.73% in the longer term (5 years). Additionally, these companies generate, on average, 8.16 (3 consecutive years) to 7.46 (5 consecutive years) more green patents. These findings imply that companies selected by green hedge funds hold sustainability-related information that has not yet been fully reflected in market prices, making it challenging for other investors to precisely evaluate their future potential in carbon reduction or green innovation. We show that green hedge fund managers are able to identify these companies whose green attributes are undervalued by the market. As a result, these positions may benefit when the market eventually incorporates this information. This edge is derived from managers' deep understanding and exploitation of the companies' underrecognized sustainability-related information and demonstrates hedge fund managers' sophisticated investment skills.

Our findings align with Ceccarelli et al. (2023), who show that "proactive" fund managers generate private information about firms' ESG characteristics and trade on this information to improve fund performance. These findings highlight hedge funds' specialized investment acumen in green investing.[20]

[insert Table 6 about here]

2. Green Factor-Timing Skills

We next examine whether green hedge funds have superior green factor-timing skills. Prior hedge fund studies provide evidence of timing skills in market returns, volatility, liquidity, and macro uncertainty (see, e.g., Chen (2007), Chen and Liang (2007), Cao et al. (2013), and Bali et al. (2014)). In our analysis, we focus on funds' green factor-timing skills and examine whether hedge funds can anticipate shifts in the green factor and adjust their asset allocation accordingly. Specifically, we test two conjectures. First, we investigate whether green hedge fund managers possess better green factor-timing skills. Second, we test whether these green factor-timing skills are associated with stronger fund performance.

We develop a green factor-timing model based on the market timing model of Henriksson and Merton (1981) and the sentiment timing model of Chen et al. (2021). Specifically, for each hedge fund, we perform the following regression using data from a 24-month backward-looking rolling window:[21]

(8) $r_{i,t} = \alpha + \beta_1 f_{green,t} + \gamma f_{green,t} \times \boldsymbol{I}(GMB_t - \overline{GMB_t}) + \sum_{j=2}^{J} \beta_j f_{j,t} + \varepsilon_{i,t}$

where $r_{i,t}$ is the excess return on fund *i* in month *t*, $f_{green,t}$ is the green factor, GMB_t is the green-minus-brown stock portfolio return from Pástor et al. (2022), and ***I***(.) is a dummy variable equal

[20] Hedge funds can incorporate environmental considerations into their investment strategies through both long and short positions. Prior research documents that short interest is higher for firms with poor environmental performance ("brown" firms) relative to those with strong environmental performance ("green" firms) (Cao, McLean, Zhan, and Zhang (2024), Liang, Pelizzon, Qu, and Getmansky Sherman (2024)). In this paper, however, our focus is on the long side of hedge fund portfolios. The role of short selling in green investing, while important, lies beyond the scope of this study.
[21] To construct equation (8), we follow the sentiment timing model proposed by Chen et al. (2021) and modify their equation (4) by replacing the tradable sentiment factor with the return spread of a green-minus-brown (GMB) portfolio.

to 1 when GMB_t is greater than its time series mean, and 0 otherwise. The coefficient γ in regression equation (8) captures the fund manager's green factor-timing ability. A manager with such skill dynamically adjusts the fund's exposure to the green factor and increases the fund's green factor exposure when the return of green assets is large, leading to a positive γ.

Next, to test whether green hedge fund managers possess better green factor-timing skills, we regress the green factor-timing skill variable γ on fund green beta and control for other characteristics in the following regression model:

(9) $Green\ factor\ timing\ skill_{i,t+1} = \beta_0 + \beta_1 \times Green\ beta_{i,t} + \sum \beta_n \times Fund\ Controls_{n,t} + \varepsilon_{i,t+1}$

where *Green factor-timing skill* is estimated from regression equation (8) and *Green beta* is estimated from regression equation (1). The coefficient β_1 captures the relation between a fund's green beta and fund managers' green factor-timing skills. A positive and significant β_1 indicates that a hedge fund with a higher green beta demonstrates more effective green factor-timing ability. The specification includes the same set of control variables for fund characteristics as in equation (2). We include strategy and time fixed effects and cluster standard errors by fund.

Panel A of Table 7 reports the regression results of equation (9). We find a positive and statistically significant association between green factor-timing ability and a fund's green beta, indicating a strong link between fund greenness and the manager's ability to time the green factor. Funds with higher exposure to green assets are better able to adjust that exposure in response to favorable conditions for green assets. Our findings reveal that although funds with higher green beta have larger allocations to green stocks, their green exposure is not constant over time. Instead, they adjust green exposure dynamically in response to changes in green-factor returns.

Finally, to investigate whether a manager's green factor-timing skills are associated with better fund performance, we regress one-month-ahead fund performance (excess return or alpha) on the green factor-timing coefficient estimated from equation (8). Panel B of Table 7 reports the regression results. Across all models, the coefficients on green factor-timing skills are positive and statistically significant. Meanwhile, fund green beta continues to exhibit a strong relation with fund performance. Consistent with our second conjecture, we find that the green factor-timing coefficient is positively associated with subsequent hedge fund performance.

Taken together, we document that green hedge fund managers exhibit exceptional green investment skills. They demonstrate the ability to identify green companies whose sustainability potential is not fully recognized by the market. They also effectively adjust their green exposure to time the green factor. Both green stock-picking and green factor-timing skills are associated with superior performance.

[insert Table 7 about here]

E. Investment Strategy Heterogeneity

We explore heterogeneity in our findings across hedge fund investment strategies. Following Bali et al. (2014), we group funds into three broad strategy groups: directional, semi-directional, and non-directional. Directional funds (long-only, CTA, emerging markets, sector, and global macro) take explicit market exposure, making them best positioned to incorporate green investing by tilting directly toward (or away from) green (brown) assets.[22] Semi-directional funds (long/short equity, event-driven, and multi-strategy) balance long and short positions, enabling them to overweight green firms while shorting brown firms. Non-directional funds (relative value

[22] We exclude short-biased funds from the directional strategy group. Grouping long-only and short-biased funds together may be inappropriate, as long-only funds typically exhibit positive green betas, whereas short-biased funds tend to have negative betas. In addition, the number of short-biased fund observations is small (87) and may not be representative. Nevertheless, including short-biased funds in the directional strategy group yields similar results.

and equity market neutral) aim to eliminate market risk. Their green exposure is therefore more indirect, typically arising from arbitrage opportunities or relative mispricing rather than broad shifts in green asset demand.

We first examine heterogeneity in fund performance and risk across hedge fund strategy groups. Panel A of Table 8 reports the performance results. We observe a positive relation between green beta and fund performance. Specifically, green beta is positively and significantly related to alpha across directional, semi-directional, and non-directional funds. Its positive relation with excess returns appears in directional and semi-directional funds but not in non-directional funds, indicating that the performance effect is greatest for directional and semi-directional strategies and weaker for non-directional funds. Panel B reports the risk results. We find that the negative relationship between green beta and risk is primarily concentrated among non-directional funds, where higher green beta is associated with significantly lower total, systematic, idiosyncratic, and tail risk. By design, non-directional funds employ arbitrage and market-neutral strategies that seek to minimize exposure to broad market movements. As a result, green exposure may be particularly valuable in these portfolios, contributing to risk reduction and enhancing overall portfolio stability.[23]

We also test the differences in the coefficients across the three strategy groups using Wald tests based on seemingly unrelated estimation (SUEST).[24] For performance, the alpha coefficient is significantly larger for directional funds than for semi-directional funds, while most other pairwise differences are not statistically significant. For risk, the coefficient on green beta is

[23] We also conduct subsample analyses by individual hedge fund strategy (e.g., long–short, event-driven, global macro, and relative value). Overall, the positive association between fund greenness and performance is broadly present across strategies, while the risk-mitigation effects are most pronounced for the more market-neutral strategies such as relative value. The fund-strategy-level results continue to support our main conclusion that the performance and risk differentials between high- and low-green-beta funds are not simply driven by differences in hedge fund strategies. We provide detailed results in Table A4 of the Online Appendix.

[24] We provide detailed results in Table A5 of the Online Appendix.

significantly more negative for non-directional funds than for the other two strategy groups across all four risk measures. Overall, the results suggest that green beta is associated with superior overall fund outcomes, but the mechanisms differ by investment strategy: performance improvements are greatest among directional funds, whereas risk mitigation is most pronounced among non-directional funds.

We next examine whether hedge funds' green investment skills vary across different strategy groups. First, for stock-picking skills, we re-estimate equation (6) within each strategy group and report the results in Panel C of Table 8. We find that stock-picking skills are more pronounced among directional funds. For directional funds, the coefficient on green beta is positive and statistically significant in both the equal-weighted and value-weighted specifications. In contrast, the corresponding coefficients for semi-directional and non-directional funds are not statistically significant in either specification. We then re-estimate equation (8) within each strategy group and report the results in Panel D of Table 8. We observe a different pattern for green factor-timing skills. In the within-group tests, only the semi-directional funds exhibit a statistically significant positive association between fund green beta and green factor-timing skills. We apply the same SUEST-based Wald tests to examine the difference between coefficients. For stock-picking skills, the coefficient on green beta is significantly larger for directional funds than for the other two groups. For factor-timing skills, however, the pairwise coefficient differences across groups are not statistically significant.

[insert Table 8 about here]

F. Hedge Fund Greenness and Climate Concerns

We now examine how climate concerns influence the behavior of hedge fund managers. Over the past decade, climate concerns have increased substantially among financial-market participants, including hedge fund managers and investors.[25] This increasing awareness can alert fund managers to the severity and urgency of climate change and thus change their investment behavior. Hedge funds may also need to adjust their holdings so that they can hedge against climate news, particularly during periods of pronounced negative climate news sentiment. We follow Engle et al. (2020) to construct an index to measure climate news sentiment from major U.S. newspapers. The index is calculated as the correlation between the text content of *The Wall Street Journal* (WSJ) and a fixed climate change vocabulary. We measure shocks to climate news sentiment as prediction errors from AR(1) models applied to the underlying WSJ climate change news index.[26] Each month, we regress the fund greenness measure (fund-level green beta) on the WSJ climate news shock in the previous month and include other control variables.[27] Table 9 tabulates the regression results. As expected, the coefficients are positive and statistically significant, suggesting that hedge funds increase their green exposure after unexpected climate news shocks.

[insert Table 9 about here]

G. Hedge Fund Greenness and Investor Response

In this section, we study hedge fund investors' responses to hedge funds' green investing. Previous studies document that mutual fund investors are more tolerant of poor performance in green mutual funds (Bollen (2007), Renneboog, Ter Horst, and Zhang (2011), El Ghoul and Karoui (2017), and Pástor and Vorsatz (2020)). We examine whether hedge fund investors similarly

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[25] Sautner, Van Lent, Vilkov, and Zhang (2023) offer corroborating evidence indicating an intensification of climate concerns subsequent to 2012. The authors assess companies' exposure to climate change by quantifying the degree to which climate change-related topics are addressed during earnings calls. Their analysis reveals a marked escalation in climate change exposure during the period spanning from 2013 to 2018.
[26] Please refer to Engle et al. (2020) for how to construct the index.
[27] Pástor et al. (2022) show evidence of stock price reactions to climate news shocks.

prioritize environmental objectives over short-term returns or instead balance them with performance.

To estimate fund flows, we follow prior research (see, e.g., Sirri and Tufano (1998)) and measure quarterly fund flows as follows:

(10) $Fund\ flows_{i,t} = \frac{[TNA_{i,t} - TNA_{i,t-1} \times (1 + R_{i,t})]}{TNA_{i,t-1}}$

where $TNA_{i,t}$ and $TNA_{i,t-1}$ are the total net assets of hedge fund *i* at times *t* and *t*–1, respectively, and $R_{i,t}$ is the raw hedge fund return from time *t*–1 to *t*.

1. Fund Greenness and Fund Flows

We first analyze the relationship between fund flows and hedge fund greenness using the following specification:

(11) $Fund\ flow_{i,t+1} = \beta_0 + \beta_1 \times Green\ fund_{i,t} + \beta_2 \times Past\ performance\ rank_{i,t}$

$+\beta_3 \times Past\ Flow_{i,t} + \sum \beta_n \times Fund\ Controls_{n,t} + \varepsilon_{i,t+1}$

where the dependent variable $Fund\ flow_{i,t+1}$ is defined in equation (10). $Green\ fund_{i,t}$ is a dummy variable that equals 1 if the fund green beta is above the median in the previous quarter and 0 otherwise. $Past\ performance\ rank_{i,t}$ is calculated as either the past 12-month fund return rank (past return rank) or alpha rank (past alpha rank).[28] $Past\ Flow_{i,t}$ is defined as fund flows in the previous quarter (quarter *t*). The specification includes the same set of control variables for fund characteristics as in equation (2). We include strategy and time fixed effects and cluster standard errors by fund.

Table 10 reports the regression results. Column (1) presents the full-sample estimates and shows that green hedge funds attract greater investor flows after controlling for past fund

[28] Past return and alpha ranks are assigned by sorting hedge fund returns and alphas into deciles, with ranks reflecting their positions within the distributions.

performance, past flows, and fund characteristics. Specifically, funds with above-median green beta, captured by the *Green fund* indicator, are associated with a 0.53% increase in investor flows. This effect is economically significant, equivalent to an inflow of \$8.4 (0.53%×396.8×4) million per year for an average hedge fund. To gain deeper insight into investors' perspectives on the green investing practices of hedge funds, we split the sample into low-alpha and high-alpha funds and re-estimate equation (11) within each group.[29] Columns (2) and (3) present the results. We observe that the incremental investor flows for green hedge funds documented in Column (1) are concentrated in the high-alpha sample. This suggests that hedge fund investors approach green investing differently compared to other investors, such as mutual fund investors. They prioritize performance and reward green hedge funds with higher inflows only when these funds also demonstrate strong returns.[30]

[insert Table 10 about here]

2. Other Factors Affecting Green Fund Flows

We further explore other factors that shape investor flows. We first investigate investors' attention to climate change. In recent years, hedge fund investors such as pension funds and endowments increasingly require their investments to align with their sustainability objectives and encourage hedge funds to adopt greener strategies. Following prior literature, we use the 2015 Paris Agreement as a cutoff to capture the shift in investor attention, as research shows the Paris Agreement raised societal awareness of climate change (Bolton and Kacperczyk (2021)). We split the sample into a pre-Paris period (2012–2014) and a post-Paris period (2015–2021) and re-

[29] High (low) alpha funds are defined as the funds with alpha above (below) the median in the previous quarter.

[30] In Online Appendix Table A6, we also examine whether investor flows display different sensitivity to the performance of high green-beta funds. We find no evidence of such behavior. Unlike mutual fund investors, who appear more tolerant of poor performance in green mutual funds, hedge fund investors do not exhibit greater tolerance for underperformance among green hedge funds (Bollen (2007), Renneboog et al. (2011), El Ghoul and Karoui (2017), and Pástor and Vorsatz (2020)).

estimate equation (11) in each subsample. Table 11 Panel A reports the results. We find that the incremental investor flows are significant only for funds with high alpha in the subsample period after the 2015 Paris Agreement. However, this relationship does not exist in the pre-Paris Agreement period or for low-alpha funds. These findings confirm that hedge fund investors' awareness of climate risk has evolved over time and, consistent with other studies, the 2015 Paris Agreement played a pivotal role. Moreover, the results reaffirm that investors are unwilling to compromise returns for green investments. They reward green hedge funds with higher inflows only when these funds can generate superior performance.

We next examine whether climate news shocks affect investors' behavior. Specifically, we augment our regression analysis in equation (11) by incorporating the WSJ climate news shock, as well as the interaction between the WSJ climate news shock variable and the Green fund variable.[31] In Table 11 Panel B, we show that the coefficient of the interaction is positive and significant. This finding indicates that investors actively allocate more capital toward green hedge funds after climate news shocks.

[insert Table 11 about here]

Over the past few years, there has been a notable increase in the number of hedge funds becoming signatories to the UNPRI. Upon becoming signatories, hedge funds are obligated to demonstrate a commitment to responsible investment practices. Building on Humphrey and Li (2021) and Liang et al. (2022), we also investigate the impact of UNPRI membership on hedge fund behavior. Using a DiD design, we find that signatories significantly increase their green asset exposure and subsequently attract more fund flows. We discuss the model and report the results in Section I of the Online Appendix and Table A7.

[31] In this test, we again restrict the sample to 2015–2021, as the fund flow effect is significant only in the post–Paris Agreement period.

IV. Robustness

We conduct a set of robustness tests to verify that our main conclusions are not driven by specific modeling choices. First, we employ an alternative method to evaluate a hedge fund's exposure to green assets by calculating the value-weighted average carbon risk score using stock holdings information from hedge fund management firms, following Liang et al. (2022). Since the carbon risk score can only be calculated at the hedge fund management firm level, we assign the same carbon risk score to each fund within the same hedge fund management firm. We reproduce the main analyses using this holdings-based carbon risk score. We report the results in Online Appendix Table A8. The results are consistent with our main findings.

Second, we construct an alternative measure of hedge fund green beta by augmenting equation (1) with additional risk factors. To address concerns that the green factor is a proxy for firm profitability or firm investment policy, we add the profitability factor (RMW) and the investment factor (CMA) from the Fama–French (2015) five-factor model. To mitigate concerns that a correlated omitted factor may bias our estimates of green betas, we also add the value factor (HML) and momentum factor (MOM) from Carhart's (1997) four-factor model. We then modify equation (1) by adding these factors in various combinations to re-estimate green beta and repeat our baseline analyses. We report the results in Online Appendix Tables A9 and A10 (Columns 1 to 10), and they remain consistent.

Third, we replace the seven-factor model of Fung and Hsieh (2004) with the new nine-factor model proposed by Chen, Li, Tang, and Zhou (2025), which they show has superior explanatory power for hedge fund returns.[32] We modify equation (1) by replacing the seven-factor

[32] The nine-factor model includes: the equity market factor; five anomaly factors—asset growth, betting-against-beta, low risk, return-on-assets, and time-series momentum; and three macro factors—the monthly change in the 10-year Treasury yield, the credit spread, and the term spread.

controls with the nine-factor model to estimate a new green beta and repeat our baseline analyses. We report the results in Online Appendix Tables A9 and A10 (Columns 11 to 12), and they remain consistent with our baseline findings.

V. Conclusion

This study examines key aspects of green investing within the hedge fund industry. We develop a return-based metric, green beta, that captures how a fund's returns covary with the green factor and allows us to measure green exposure at the individual fund level. We find that greener hedge funds deliver stronger performance on average. More importantly, we show that green exposure is associated with lower subsequent risk. Greener funds exhibit lower total volatility, systematic risk, idiosyncratic risk, and tail risk. These risk-mitigation and outperformance effects are especially pronounced during adverse periods, such as market downturns and climate-related stress states. Our findings add nuance to the conventional view that environmentally sustainable investing necessarily comes at the expense of financial performance. We show that skilled hedge fund managers can "do well by doing good," as green investing is associated with both stronger performance and more resilient risk profiles.

We document that return and risk channels operate differently across investment strategies. Green beta is associated with superior overall fund outcomes, but the mechanisms differ by strategy: performance improvements are greatest among directional funds, whereas risk mitigation is most pronounced among non-directional funds.

We further show that green hedge fund managers exhibit stronger green stock-picking and green factor-timing skills. The evidence suggests that these managers can process complex sustainability information to identify undervalued green stocks and capitalize on fluctuations in the green factor. We also examine investor responses and find that greener funds attract higher investor flows, especially in the post-2015 Paris Agreement period. However, this flow effect is concentrated among high-performing funds, suggesting that hedge fund investors value sustainability while remaining strongly performance-oriented.

Finally, we find that hedge funds increase their green exposure following climate news shocks. Investor flows toward green hedge funds also increase after these events. As views on carbon risk and climate policy continue to evolve, our study provides timely evidence on how hedge funds approach green investing. Our findings highlight hedge funds' focus on risk and performance, ability to time green factor exposure, and skill in selecting green assets that generate value.

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Figure 1. Hedge Fund Holdings and Trading toward Green Assets

Figure 1A plots the trends in hedge funds' holdings of green industry companies and brown industry companies over time. Each year, we calculate the average carbon risk score for each industry based on the carbon risk scores of its constituent companies. Industries are then sorted into terciles based on the industry's carbon risk score. Green industries are defined as those in the lowest carbon risk tercile, while brown industries are those in the highest tercile. Green industry companies are defined as companies in the green industries. Brown industry companies are defined as companies in the brown industries. Weight is defined as the holding value of companies in each tercile divided by the total holding value of hedge funds. Figure 1B plots the average weight of hedge fund quarterly net purchases (total purchases minus total sales) sorted by companies' industry. Figures 1C and 1D plot the weight of hedge fund quarterly net purchases (total purchases minus total sales) sorted by companies' industry. Each year, we calculate the average carbon risk score for each industry based on the carbon risk scores of its constituent companies. Industries are then sorted into three ranks based on the industry's carbon risk score. Green industries are defined as those in the lowest carbon risk tercile, while brown industries are those in the highest tercile. Next, within each industry, companies are further sorted into three additional ranks based on their carbon risk scores. Figure 1C reports hedge funds' net purchases in the green industry. Figure 1D reports hedge funds' net purchases in the brown industry. The sample includes all the 13F stocks held by hedge funds from TASS, HFR, and Morningstar CISDM databases. The sample period is from 2012 to 2021.

Figure 1A. Hedge Fund Holdings by Industry

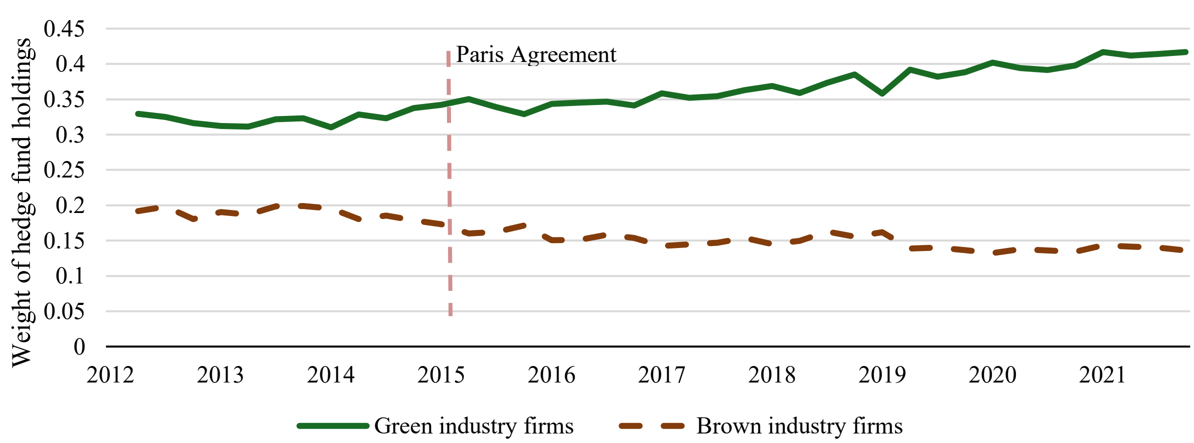

Figure 1B. Hedge Fund Net Purchase by Industry

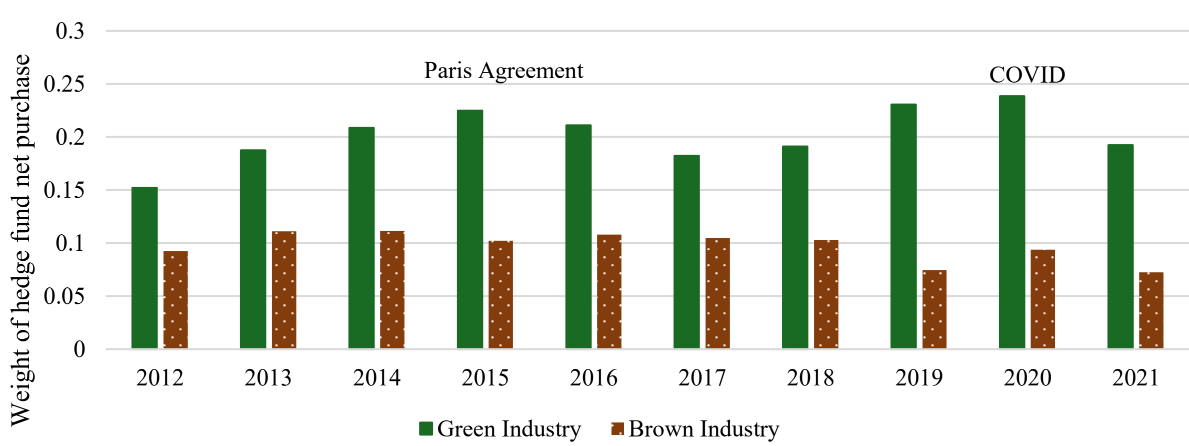

Figure 1C. Hedge Fund Net Purchase in the Green Industry

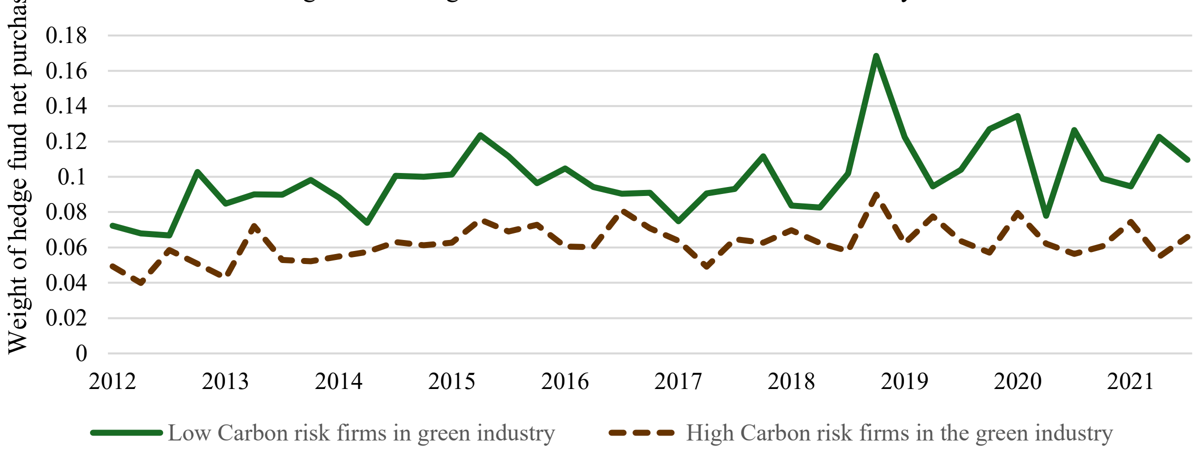

Figure 1D. Hedge Fund Net Purchase in the Brown Industry

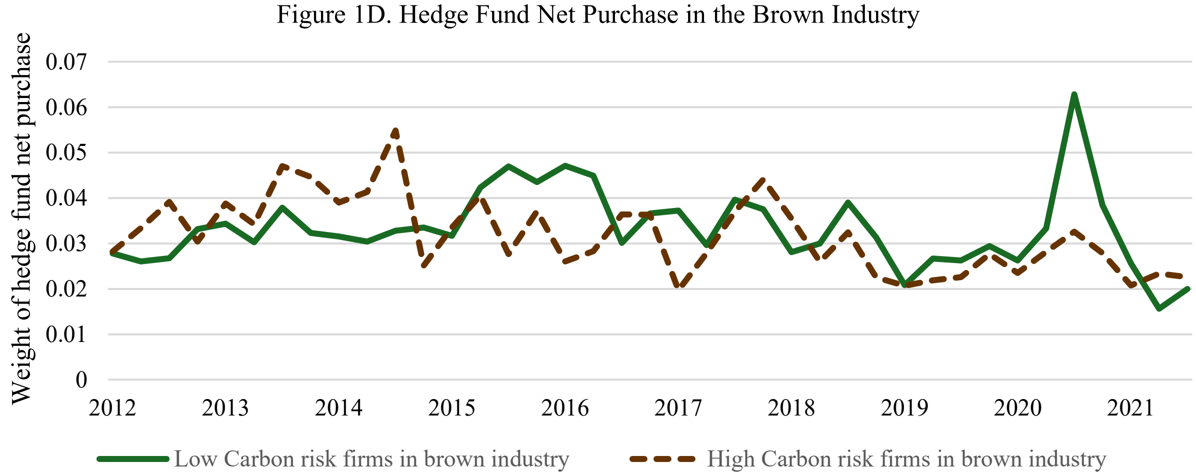

Table 1. Summary Statistics

This table presents summary statistics for a sample of U.S. equity-oriented hedge funds over the period 2012–2021. *AUM* is the fund's reported assets under management at the end of each month ($ million). *Management fee* and *Incentive fee* are reported as percentages. *High water mark* is a dummy variable equal to one if the hedge fund uses a high water mark and zero otherwise. *Leveraged* is a dummy variable equal to one if the hedge fund uses leverage, and zero otherwise. *Redemption period* is the number of days' advance notice that an investor must give the fund to withdraw their capital. *Lock-up period* is measured in months. *Rate of return* is the monthly fund return net of fees (%). *Alpha* is calculated using the Fung and Hsieh (2004) seven-factor model. *Fund age* measures years since the fund's inception date. *Flow* is the monthly net inflows of funds scaled by fund assets. *Total risk* is measured as the standard deviation of the fund's monthly excess returns over a rolling window of the prior 24 months. *Idiosyncratic risk* is measured as the standard deviation of the residuals from the fund's factor model used to estimate alpha. *Systematic risk* is then measured as the component of total risk attributable to common factors, computed from the variance decomposition between total and idiosyncratic risk. *Tail risk is* measured as the fund's two-year 95% value-at-risk (VaR). *Green beta* is defined as the coefficient of the green factor (Pástor et al. (2022)) when regressing fund monthly excess return on the green factor and Fung and Hsieh's (2004) seven factors.

	Mean	Median	S.D.	Min	Max
AUM (US$m)	396.773	100.000	837.313	1.000	5004.000
Management fee (%)	1.395	1.500	0.465	0.000	4.000
Incentive fee (%)	16.710	20.000	6.948	0.000	50.000
High water mark (dummy)	0.838	1.000	0.368	0.000	1.000
Leveraged (dummy)	0.638	1.000	0.480	0.000	1.000
Redemption period (days)	77.305	90.000	77.026	0.000	365.000
Lock-up period (months)	5.219	0.000	7.225	0.000	48.000
Rate of return (%)	0.564	0.560	3.276	-10.390	11.039
Alpha (%)	0.144	0.141	0.750	-7.919	5.940
Fund age	10.656	9.000	6.491	0.000	37.000
Flow (%)	0.001	0.000	0.067	-0.252	0.437
Total risk (%)	2.977	2.513	2.029	0.021	26.312
Systematic risk (%)	2.301	1.902	1.733	0.017	23.816
Idiosyncratic risk (%)	1.747	1.436	1.283	0.008	13.316
Tail risk (%)	5.313	4.700	3.085	-0.610	10.390
Green beta	-0.003	0.015	1.109	-8.092	11.479

Table 2. Hedge Fund Green Beta

This table reports summary statistics for fund green beta across hedge fund investment strategies. *Green beta* is defined as the coefficient of the green factor (Pástor et al. (2022)) when regressing fund monthly excess return on the green factor and Fung and Hsieh's (2004) seven factors. We categorize funds into twelve different investment strategies following Liang et al. (2022).

Fund Strategy	Green beta (mean)	Std. dev.	Observations
Long only	0.678	0.714	124
Multi-strategy	0.111	0.738	3,313
Global macro	0.108	1.060	6,372
Long/short equity	0.076	1.212	37,709
Equity market neutral	-0.118	0.648	2,575
Event-driven	-0.145	0.908	9,059
CTA	-0.223	0.360	67
Relative value	-0.274	0.880	6,215
Other	-0.391	0.329	381
Sector	-0.638	0.680	39
Emerging markets	-0.704	1.738	900
Short bias	-0.710	0.754	87

Table 3. Hedge Fund Green Beta and Fund Performance

This table shows the relationship between hedge fund green beta and performance. Panel A reports the univariate analysis of fund performance and fund green beta. Each month, funds are sorted into five quintiles based on fund green beta. Fund green beta increases monotonically from the lowest quintile (Rank 1) to the highest quintile (Rank 5). Panel B reports results from the regression of fund performance on fund green beta and other characteristics, as specified in equation (2). The dependent variable in Column (1) is Fung and Hsieh's (2004) seven-factor alpha (%). The dependent variable in Column (2) is funds' monthly excess return (%). *Green beta* is defined as the coefficient of the green factor (Pástor et al. (2022)) when regressing fund monthly excess return on the green factor and Fung and Hsieh's (2004) seven factors. The regression includes the following control variables: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The *t*-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Panel A: Hedge Fund Performance Sorted by Fund Green Beta

Green beta	Alpha	Excess Return
Rank 5 (highest)	0.240	0.723
Rank 4	0.166	0.491
Rank 3	0.176	0.419
Rank 2	0.108	0.425
Rank 1 (lowest)	0.020	0.376
Highest-Lowest	0.220***	0.347***

Panel B: Hedge Fund Green Beta and Fund Performance

	Alpha	Excess Return
	1	2
Green beta	0.074***	0.122***
	(5.09)	(8.08)
Log (size)	0.039***	-0.009
	(5.44)	(-1.04)
Fund age	-0.017***	-0.003
	(-8.70)	(-1.42)
Lock-up period	-0.000	0.003
	(-0.26)	(1.21)
Management fee	0.195***	0.035
	(6.12)	(0.91)
Incentive fee	0.006**	-0.004
	(1.98)	(-1.09)
High water mark	0.119**	0.080
	(2.11)	(1.26)
Leveraged	-0.000	-0.019
	(-0.01)	(-0.60)
Time FE	YES	YES
Strategy FE	YES	YES
Observations	66,841	66,841
R-squared	0.108	0.248

Table 4. Hedge Fund Green Beta and Fund Risk

This table reports results from the regression of fund risk on fund green beta and other characteristics, as specified in equation (3). The dependent variables in Columns (1)–(4) are the fund's total risk, systematic risk, idiosyncratic risk, and tail risk, respectively. *Total risk* is measured as the standard deviation of the fund's monthly excess returns over a rolling window of the prior 24 months. *Idiosyncratic risk* is measured as the standard deviation of the residuals from the fund's factor model used to estimate alpha. *Systematic risk* is then measured as the component of total risk attributable to common factors, computed from the variance decomposition between total and idiosyncratic risk. *Tail risk is* measured as the fund's two-year 95% value-at-risk (VaR). *Green beta* is defined as the coefficient of the green factor (Pástor et al. (2022)) when regressing fund monthly excess return on the green factor and Fung and Hsieh's (2004) seven factors. The regression includes the following control variables: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The *t*-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

	Total Risk	Systematic Risk	Idiosyncratic Risk	Tail Risk
	1	2	3	4
Green beta	-0.075**	-0.062*	-0.067**	-0.121**
	(-2.23)	(-1.88)	(-2.11)	(-2.16)
Log (size)	-0.090***	-0.083***	-0.100***	-0.127***
	(-3.78)	(-3.26)	(-5.08)	(-3.00)
Fund age	0.007	0.014**	-0.017***	0.023**
	(1.15)	(2.11)	(-3.18)	(2.05)
Lock-up period	0.015**	0.016**	0.012**	0.018*
	(2.25)	(2.34)	(2.05)	(1.70)
Management fee	0.035	-0.110	0.284***	-0.011
	(0.38)	(-1.19)	(3.27)	(-0.06)
Incentive fee	-0.012	-0.024**	0.012*	-0.022
	(-1.40)	(-2.55)	(1.66)	(-1.49)
High water mark	0.133	0.153	0.104	0.239
	(0.89)	(0.96)	(0.78)	(0.93)
Leveraged	-0.076	-0.114	0.084	-0.214
	(-0.81)	(-1.15)	(1.05)	(-1.31)
Time FE	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES
Observations	66,841	66,841	66,841	66,841
R-squared	0.249	0.261	0.152	0.245

Table 5. Hedge Fund Performance and Risk During Adverse States

This table examines hedge fund performance and risk during adverse states. Panel A tests hedge fund performance and risk during market downturns proxied by market crash months. We define market crash months as months in which the S&P 500 index return falls within the bottom 1% of its return distribution over a 30-year period (1992-2021). *Market crash* is a dummy variable that equals one for market crash months and zero otherwise. Panel B reports hedge fund performance and risk during climate-related stress states. *High CPU* equals one when the climate policy uncertainty (CPU) index falls within the top quintile of its 30-year distribution, with the CPU index developed by Gavriilidis et al. (2026). Green beta is defined in equation (1). The dependent variables in Columns (1) and (2) are alpha and excess return, respectively. The dependent variables in Columns (3)–(6) are total risk, systematic risk, idiosyncratic risk, and tail risk. Control variables include the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The *t*-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Panel A: Hedge Fund Performance and Risk During Market Downturns

	Performance		Risk			
	Alpha	Excess Return	Total Risk	Systematic Risk	Idiosyncratic Risk	Tail Risk
VARIABLES	1	2	3	4	5	6
Green beta * Market crash	0.110**	0.188***	-0.127	-0.179***	0.092	-0.253***
	(2.21)	(3.52)	(-0.73)	(-4.79)	(0.92)	(-7.03)
Green beta	0.074***	0.121***	-0.091**	-0.061	-0.068**	-0.120*
	(5.05)	(3.05)	(-2.08)	(-1.65)	(-2.12)	(-1.93)
Log (size)	0.039***	-0.009	-0.133***	-0.083***	-0.100***	-0.127***
	(5.44)	(-0.75)	(-4.27)	(-3.25)	(-5.08)	(-2.98)
Fund age	-0.017***	-0.003	0.002	0.014**	-0.017***	0.023**
	(-8.71)	(-0.73)	(0.29)	(2.09)	(-3.18)	(1.99)
Lock-up period	-0.000	0.002	0.021**	0.016**	0.012**	0.018*
	(-0.27)	(0.91)	(2.43)	(2.35)	(2.05)	(1.71)
Management fee	0.195***	0.035	0.097	-0.110	0.284***	-0.011
	(6.12)	(0.66)	(0.81)	(-1.18)	(3.27)	(-0.06)
Incentive fee	0.006**	-0.004	-0.013	-0.024**	0.012*	-0.022
	(1.98)	(-0.74)	(-1.16)	(-2.54)	(1.66)	(-1.48)
High water mark	0.119**	0.080	0.165	0.153	0.104	0.239
	(2.11)	(1.22)	(0.83)	(0.96)	(0.78)	(0.93)
Leveraged	-0.000	-0.019	-0.043	-0.114	0.084	-0.215
	(-0.01)	(-0.47)	(-0.35)	(-1.15)	(1.05)	(-1.31)
Time FE	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES
Observations	66,841	66,841	66,841	66,841	66,841	66,841
R-squared	0.108	0.248	0.224	0.261	0.152	0.245

Panel B: Hedge Fund Performance and Risk During Climate-Related Stress States

	Performance		Risk			
	Alpha	Excess Return	Total Risk	Systematic Risk	Idiosyncratic Risk	Tail Risk
VARIABLES	1	2	3	4	5	6
Green beta * High CPU	0.068***	0.160*	-0.292***	-0.216***	-0.178***	-0.196**
	(2.89)	(1.88)	(-3.48)	(-2.69)	(-3.67)	(-2.32)
Green beta	0.058***	0.084*	-0.022	-0.010	-0.025	-0.075
	(3.90)	(1.77)	(-0.45)	(-0.24)	(-0.78)	(-1.15)
Log (size)	0.039***	-0.010	-0.131***	-0.082***	-0.099***	-0.125***
	(5.40)	(-0.84)	(-4.29)	(-3.25)	(-5.11)	(-2.96)
Fund age	-0.017***	-0.003	0.002	0.014**	-0.017***	0.023**
	(-8.73)	(-0.75)	(0.31)	(2.11)	(-3.17)	(2.00)
Lock-up period	-0.001	0.002	0.021**	0.016**	0.012**	0.018*
	(-0.33)	(0.82)	(2.48)	(2.39)	(2.11)	(1.74)
Management fee	0.194***	0.032	0.101	-0.107	0.286***	-0.008
	(6.10)	(0.62)	(0.85)	(-1.16)	(3.31)	(-0.05)
Incentive fee	0.006**	-0.004	-0.014	-0.025**	0.012*	-0.022
	(1.99)	(-0.72)	(-1.18)	(-2.57)	(1.66)	(-1.49)
High water mark	0.118**	0.077	0.170	0.157	0.107	0.243
	(2.09)	(1.18)	(0.86)	(0.99)	(0.80)	(0.95)
Leveraged	-0.000	-0.020	-0.042	-0.113	0.084	-0.214
	(-0.01)	(-0.49)	(-0.35)	(-1.15)	(1.06)	(-1.31)
Time FE	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES
Observations	66,841	66,841	66,841	66,841	66,841	66,841
R-squared	0.110	0.249	0.228	0.264	0.156	0.246

Table 6. Green Hedge Fund Stock-Picking Skills

This table reports the stock-picking skills of green hedge funds. Panel A reports results from the regression of hedge fund stock-picking skills on fund green beta and other characteristics, as specified in equation (6). Hedge fund stock-picking skills are defined in equation (5) based on the 13F holdings data. *Green beta* is measured as the coefficient of the green factor (Pástor et al. (2022)) when regressing fund monthly excess return on the green factor and Fung and Hsieh's (2004) seven factors. The regression includes the following control variables: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. In Columns (1) and (2), all variables are aggregated at the hedge fund management firm level using equal-weighted averages. In Columns (3) and (4), all variables are aggregated at the firm level using value-weighted averages. We infer a hedge fund management firm's strategy based on the strategy of its largest fund. Panel B reports results from the regression examining the relationship between the change in green companies' environmental performance and the extent to which a company is favored by green hedge funds, as specified in equation (7). Green companies are defined as companies ranked in the lowest tercile of carbon risk. The dependent variables in Columns (1) to (3) are changes in the level of carbon risk of green companies in one, three, and five years, respectively. The dependent variables in Columns (4) to (6) are changes in the number of green patents the green companies file in one, three, and five years, respectively. *Overweight* measures the difference between the average stock's weight in green hedge funds and the average stock's weight in the overall market portfolio. A green hedge fund is defined as a fund ranked in the highest quintile based on fund green beta. All columns control for a company's book-to-market ratio (*BM Ratio*), annual return (*Return*), natural logarithm of company size (*Log (size)*), and return on assets (*ROA*). The *t*-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Panel A: Hedge Fund Management Firm Green Beta and General Stock-Picking Skills

	Stock-picking skills (Equally-weighted firm green beta)		Stock-picking skills (Value-weighted firm green beta)	
	1	2	3	4
Green beta	0.079**	0.077**	0.071**	0.070**
	(2.52)	(2.42)	(2.26)	(2.21)
Log (size)		-0.028		-0.027
		(-1.60)		(-1.58)
Fund age		-0.001		-0.000
		(-0.17)		(-0.05)
Lock-up period		-0.003		-0.002
		(-0.76)		(-0.51)
Management fee		0.097		0.071
		(1.08)		(0.79)
Incentive fee		0.001		-0.000
		(0.14)		(-0.03)
High water mark		-0.024		-0.022
		(-0.22)		(-0.21)
Leveraged		-0.072		-0.044
		(-0.96)		(-0.58)
Time FE	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES
Observations	7,461	7,461	7,461	7,461
R-squared	0.028	0.029	0.027	0.028

Panel B. Green Hedge Fund Overweight and Company Sustainability Potential

	Δ Carbon risk			Δ Green patent		
	Δ Carbon risk t1-t0	Δ Carbon risk t3-t0	Δ Carbon risk t5-t0	Δ Green patent t1-t0	Δ Green patent t3-t0	Δ Green patent t5-t0
	1	2	3	4	5	6
Overweight	-1.193	-4.885***	-6.373***	15.774	81.574*	74.641*
	(-1.21)	(-3.60)	(-2.72)	(1.47)	(1.69)	(1.87)
BM Ratio	0.093	0.005	-0.372	-2.032**	-7.118***	-12.108**
	(0.88)	(0.02)	(-0.91)	(-2.29)	(-2.75)	(-2.46)
Return	0.199	-0.072	-0.330**	-0.678	-1.341	0.209
	(1.41)	(-0.93)	(-2.08)	(-0.98)	(-1.19)	(0.24)
Log (size)	-0.025	-0.096**	-0.141**	0.640***	1.825***	3.441***
	(-1.24)	(-2.33)	(-2.11)	(3.40)	(3.52)	(3.20)
ROA	-0.334*	0.034	0.522	1.867	9.124	11.192
	(-1.75)	(0.06)	(0.56)	(0.96)	(1.58)	(1.13)
Time FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Observations	2,127	1,566	1,076	1,852	1,335	843
R-squared	0.048	0.079	0.115	0.055	0.103	0.190

Table 7. Green Hedge Fund Green Factor-Timing Skills

This table reports hedge funds' green factor-timing skills. Panel A reports results from the regression of hedge fund green factor-timing skills on fund green beta and other characteristics, as specified in equation (9). The dependent variable is the hedge fund's green factor-timing skills, which is defined as the green coefficient (γ) in equation (8). *Green beta* is measured as the coefficient of the green factor (Pástor et al. (2022)) when regressing fund monthly excess return on the green factor and Fung and Hsieh's (2004) seven factors. Panel B reports results from the regression of fund performance on green factor-timing skills and other characteristics. The dependent variable in Columns (1) and (2) is Fung and Hsieh's (2004) seven-factor alpha (%). The dependent variable in Columns (3) and (4) is the fund's monthly excess return (%). All regressions include the following control variables: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The *t*-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Panel A. Green Factor-Timing Skills and Fund Green Beta

	Green factor-timing skills		
	1	2	3
Green beta	0.112**	0.110**	0.123**
	(2.29)	(2.19)	(2.41)
Log (size)		0.066**	0.065**
		(2.54)	(2.50)
Fund age		-0.014***	-0.014***
		(-2.82)	(-2.80)
Lock-up period		-0.009	-0.009
		(-1.52)	(-1.48)
Management fee		-0.136	-0.129
		(-1.20)	(-1.13)
Incentive fee		-0.005	-0.005
		(-0.52)	(-0.57)
High water mark		0.121	0.127
		(0.67)	(0.70)
Leveraged		0.030	0.026
		(0.34)	(0.29)
Time FE	YES	YES	NO
Strategy FE	YES	YES	NO
Strategy-time FE	NO	NO	YES
Observations	66,841	66,841	66,768
R-squared	0.049	0.053	0.086

Panel B. Green Factor-Timing Skills and Fund Performance

	Alpha		Excess return	
	1	2	3	4
Green factor-timing skill	0.028***	0.027***	0.035***	0.034***
	(3.15)	(3.03)	(5.00)	(4.89)
Green beta	0.066***	0.064***	0.145***	0.143***
	(4.55)	(4.43)	(9.82)	(9.52)
Log (size)	0.039***	0.038***	0.020**	0.020**
	(5.53)	(5.36)	(2.48)	(2.48)
Fund age	-0.017***	-0.017***	-0.004	-0.004*
	(-8.66)	(-8.59)	(-1.54)	(-1.81)
Lock-up period	-0.000	-0.000	0.002	0.002
	(-0.11)	(-0.07)	(0.92)	(0.88)
Management fee	0.199***	0.200***	0.020	0.032
	(6.33)	(6.30)	(0.56)	(0.90)
Incentive fee	0.006**	0.007**	-0.005	-0.005
	(2.13)	(2.23)	(-1.35)	(-1.49)
High water mark	0.119**	0.110**	0.069	0.078
	(2.24)	(2.06)	(1.22)	(1.38)
Leveraged	-0.002	0.002	-0.037	-0.029
	(-0.07)	(0.07)	(-1.18)	(-0.94)
Time FE	YES	NO	YES	NO
Strategy FE	YES	NO	YES	NO
Strategy-time FE	NO	YES	NO	YES
Observations	66,841	66,768	66,841	66,768
R-squared	0.116	0.140	0.252	0.309

Table 8. Strategy Groups

This table reports the relationship between green beta and fund performance, risk, and skills by strategy groups. Panel A shows results from the regression of fund performance on fund green beta and other characteristics based on three broad categories of investment strategies: Directional (long-only, CTA, emerging markets, sector, and global macro), semi-directional (long/short equity, event-driven, and multi-strategy funds), and non-directional (relative value and equity market neutral). *Green beta* is defined in equation (1). Panel B reports the relationship between green beta and fund risk by strategy groups. Panel C tabulates the relationship between green beta and fund stock-picking skills by strategy groups. Stock-picking skills are defined in equation (5). Panel D shows the relationship between green beta and fund green factor-timing skills by strategy groups. Green factor-timing skills are defined in equation (8). All regressions include the following control variables: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The *t*-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Panel A: Hedge Fund Performance by Strategy Groups

	Directional		Semi-directional		Non-directional	
	Alpha	Excess Return	Alpha	Excess Return	Alpha	Excess Return
	1	2	3	4	5	6
Green beta	0.175***	0.102**	0.059***	0.133***	0.112***	0.056
	(4.39)	(2.37)	(3.66)	(7.66)	(3.01)	(1.33)
Fund Controls	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES
Observations	7,502	7,502	50,081	50,081	8,789	8,789
R-squared	0.156	0.138	0.099	0.295	0.241	0.234

Panel B: Hedge Fund Risk by Strategy Groups

	Directional				Semi-directional				Non-directional			
	Total risk	Sys-risk	Idio-risk	Tail risk	Total risk	Sys-risk	Idio-risk	Tail risk	Total risk	Sys-risk	Idio-risk	Tail risk
	1	2	3	4	5	6	7	8	9	10	11	12
Green beta	-0.101	-0.085	-0.055	-0.224	-0.029	-0.012	-0.028	-0.007	-0.770***	-0.563***	-0.528***	-1.206***
	(-1.20)	(-1.50)	(-0.85)	(-1.41)	(-0.59)	(-0.32)	(-0.78)	(-0.11)	(-7.17)	(-7.05)	(-7.04)	(-7.17)
Fund Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	7,502	7,502	7,502	7,502	50,081	50,081	50,081	50,081	8,789	8,789	8,789	8,789
R-squared	0.306	0.320	0.266	0.237	0.189	0.230	0.125	0.230	0.364	0.369	0.349	0.318

Panel C. Hedge Fund Stock-Picking Skills by Strategy Groups

	Stock-picking skills					
	Directional		Semi-directional		Non-directional	
	EW	VW	EW	VW	EW	VW
VARIABLES	1	2	3	4	5	6
Green beta	0.327***	0.293***	0.029	0.024	0.075	0.083
	(7.20)	(4.18)	(0.85)	(0.70)	(0.82)	(0.95)
Fund Controls	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES
Observations	600	600	6,010	6,010	814	814
R-squared	0.135	0.133	0.031	0.030	0.094	0.094

Panel D. Hedge Fund Green Factor-Timing Skills by Strategy Groups

	Green factor-timing skills		
	Directional	Semi-directional	Non-directional
VARIABLES	1	2	3
Green beta	-0.038	0.157***	0.032
	(-0.30)	(2.69)	(0.51)
Fund Controls	YES	YES	YES
Time FE	YES	YES	YES
Strategy FE	YES	YES	YES
Observations	7,502	50,081	8,789
R-squared	0.136	0.048	0.111

Table 9. Hedge Fund Green Beta and Climate News Shock

This table reports results from the regression of fund green beta on climate news shock measured from the WSJ index and other characteristics. The variable of interest is WSJ climate news shock, which is calculated as the prediction errors from AR(1) models applied to the underlying WSJ climate change news index. The control variables include the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The *t*-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

	Green beta		
	1	2	3
Climate news shock	0.581**	0.574**	0.570**
	(2.28)	(2.26)	(2.22)
Fund Controls	NO	YES	YES
Time FE	YES	YES	NO
Strategy FE	YES	YES	NO
Strategy-time FE	NO	NO	YES
Observations	66,201	66,201	66,200
R-squared	0.036	0.047	0.064

Table 10. Hedge Fund Greenness and Fund Flows

This table reports results from the regression of fund flows on green fund and other characteristics, as specified in equation (11). The dependent variable is quarterly fund flows, which equals the percentage change in TNA after adjusting for the fund's total return, as defined in equation (10). The variable of interest is *Green fund*, which is a dummy variable that equals 1 if the green beta is above the median in the previous quarter and 0 otherwise. The dependent variable is in quarter $t + 1$ and all the independent variables are in quarter t. Column (1) reports the results from the full sample. Columns (2) and (3) report the subsample results on the low-alpha funds and high-alpha funds. Low-alpha funds are defined as funds with an alpha below the median in the previous quarter. High-alpha funds are defined as funds with alpha above the median in the previous quarter. *Past return rank* is defined as the decile rank of a hedge fund's return in the previous quarter. *Past flow* is measured as the hedge fund's flow in the previous quarter. Control variables include: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

	Flow (Full sample)	Flow (Low-alpha funds)	Flow (High-alpha funds)
	1	2	3
Green fund	0.530***	0.296	0.453*
	(3.14)	(1.27)	(1.95)
Past return rank	0.840***	0.824***	0.707***
	(13.76)	(10.63)	(8.02)
Past flow	0.283***	0.225***	0.287***
	(22.38)	(13.92)	(18.79)
Fund Controls	YES	YES	YES
Time FE	YES	YES	YES
Strategy FE	YES	YES	YES
Observations	22,631	10,791	11,840
R-squared	0.125	0.096	0.135

Table 11. Other Factors Affecting Fund Flows

This table examines factors that affect hedge fund flows. Panel A reports results from the regression of fund flows on the green fund and other characteristics, before and after the 2015 Paris Agreement. The variable of interest is *Green fund*, which is a dummy variable that equals 1 if the green beta is above the median in the previous quarter and 0 otherwise. *Past return rank* is defined as the decile rank of a hedge fund's return in the previous quarter. *Past flow* is measured as the hedge fund's flow in the previous quarter. Low-alpha funds are defined as funds with an alpha below the median in the previous quarter. High-alpha funds are defined as funds with alpha above the median in the previous quarter. Panel B reports results from the regression of fund flows on Green fund, WSJ climate news shock, their interaction, and other characteristics. The WSJ climate news shock is calculated as the prediction errors from AR(1) models applied to the underlying WSJ climate change news index. Regressions in Panel B use data from the post-Paris Agreement period from 2015 to 2021. The control variables include: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The *t*-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Panel A: Fund Flows Before and After the 2015 Paris Agreement

	Pre-Paris Period		Post-Paris Period	
	Low-alpha funds	High-alpha funds	Low-alpha funds	High-alpha funds
	1	2	3	4
Green fund	0.168	0.324	0.319	0.582**
	(0.47)	(0.85)	(1.11)	(2.13)
Past return rank	0.801***	0.834***	0.576***	0.470***
	(7.60)	(7.23)	(7.61)	(5.38)
Past flow	0.264***	0.362***	0.221***	0.246***
	(10.49)	(17.71)	(11.65)	(14.66)
Fund Controls	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES
Observations	4,003	4,244	6,788	7,596
R-squared	0.107	0.185	0.089	0.107

Panel B: Fund Flows and Climate News Shock (Post-Paris Period)

	Flow	
	1	2
Green fund * Climate news shock	8.738***	8.547***
	(4.39)	(3.97)
Green fund	0.521*	0.508*
	(1.86)	(1.67)
Past return rank	0.871***	0.803***
	(8.52)	(7.54)
Past flow	0.322***	0.290***
	(15.71)	(13.19)
Fund Controls	NO	YES
Time FE	YES	YES
Strategy FE	YES	YES
Observations	7,291	6,314
R-squared	0.138	0.134

Are the Hedges of Funds Green?

Online Appendix

Section I. Effect of Joining UNPRI

We use a Difference-in-Difference (DiD) model to explore whether joining the UNPRI leads hedge funds to change their green investing practices and increase their exposure to green assets. Because UNPRI signatory status is determined at the hedge fund management firm level, we aggregate fund green beta and other control variables at the management firm level and use the following specification:

$$Greenness_{j,t} = \beta_0 + \beta_1 * UNPRI * Post + \sum \beta_n * Fund\ Controls_{n,t} + \varepsilon_{j,t} \quad (12)$$

where the dependent variable $Greenness$ is hedge fund green beta measured at the management firm level, calculated using either equal-weighted or value-weighted methods. $UNPRI$ takes a value of 1 if a hedge fund management firm is a UNPRI signatory and 0 otherwise. $Post$ takes a value of 1 after the hedge fund management firm signs the UNPRI and 0 before. The main variable of interest is the interaction term of $UNPRI$ and $Post$. We control for fund firm fixed effects and time fixed effects, which absorb the two dummy variables of $UNPRI$ and $Post$. All other control variables are defined the same as in previous equations. Panel A of Table A7 reports the regression results. The coefficient of the interaction term is positive and significant. This indicates that after signing the UNPRI initiative, hedge fund management firms actively increase their exposure to green assets, as reflected in higher green beta.

We further examine how investors respond to hedge funds' decision to join the UNPRI. We adapt the regression model in equation (11) to a DiD framework and use annual fund flows aggregated at the firm level as the dependent variable. Panel B of Table A7 presents the results. The coefficients for the interaction term are all positive and significant. This indicates that investors react favorably to hedge fund firms after they sign the UNPRI.

Section II. Additional Tables

Table A1. Correlation Matrix between Green Beta and the Other Betas

	β_green	β_market	β_PTFSBD	β_PTFSFX	β_PTFSCOM	β_size	β_bdm	β_credit
β_green	1							
β_market	0.16***	1						
β_PTFSBD	-0.14***	-0.08***	1					
β_PTFSFX	0.14***	0.10***	-0.44***	1				
β_PTFSCOM	0.00	0.01***	0.05***	-0.24***	1			
β_size	0.00	0.21***	0.01***	-0.12***	0.07***	1		
β_bdm	-0.04***	-0.01*	0.29***	-0.31***	0.05***	-0.01***	1	
β_credit	0.09***	0.25***	-0.15***	-0.06***	0.11***	-0.03***	0.37***	1

This table reports the correlation between green beta and the other seven betas in the Fung and Hsieh (2004) seven-factor model. Green beta (β_green) is measured as the coefficient of the green factor (Pástor et al., 2022) when regressing fund monthly return on the green factor and Fung and Hsieh (2004) seven-factor model. Market beta (β_market) is the coefficient of the market factor. β_PTFSBD is the coefficient of the excess returns on portfolios of lookback straddle options on bonds. β_PTFSFX is the coefficient of the excess returns on portfolios of lookback straddle options on currencies. β_PTFSCOM is the coefficient of the excess returns on portfolios of lookback straddle options on commodities. β_size is the coefficient of the small-minus-big factor. β_bdm is the coefficient of the change in the constant maturity yield of the US ten-year Treasury bond. β_credit is the coefficient of the change in the credit spread of Moody's BAA bond over the ten-year Treasury bond.

Table A2. Persistence of Green Beta

		1 (low)	2	3	4	5 (high)
Panel A: Subsequent 1-Month Horizon						
Initial Rank	1 (low)	85.7%	11.7%	1.6%	0.6%	0.4%
	2	12.0%	68.2%	16.0%	3.0%	0.7%
	3	1.5%	16.4%	64.6%	15.9%	1.6%
	4	0.6%	2.9%	16.2%	68.1%	12.1%
	5 (high)	0.3%	0.6%	1.5%	12.3%	85.2%
Panel B: Subsequent 6-Month Horizon						
		1 (low)	2	3	4	5 (high)
Initial Rank	1 (low)	63.6%	19.9%	7.7%	5.1%	3.7%
	2	19.5%	40.2%	23.0%	12.1%	5.2%
	3	7.6%	22.7%	39.2%	22.5%	7.9%
	4	5.6%	11.6%	22.1%	40.2%	20.5%
	5 (high)	4.3%	5.3%	8.0%	20.3%	62.1%
Panel C: Subsequent 12-Month Horizon						
		1 (low)	2	3	4	5 (high)
Initial Rank	1 (low)	51.4%	20.0%	11.0%	9.1%	8.5%
	2	19.3%	31.5%	23.4%	16.4%	9.4%
	3	10.4%	23.2%	32.6%	22.9%	11.0%
	4	9.8%	15.6%	22.2%	31.2%	21.2%
	5 (high)	10.1%	9.6%	10.9%	20.6%	48.8%

This table reports transition matrices of green beta over one-, six-, and 12-month horizons. Each month, we assign individual hedge funds into 5 quintiles portfolios based on their green beta (estimated from a 24-month rolling window). We then track their future reassignments based on green beta.

Table A3. Hedge Fund Performance and Risk During Adverse States

Panel A: Hedge Fund Performance and Risk During Market Downturns

	Performance		Risk			
	Alpha	Excess Return	Total Risk	Systematic Risk	Idiosyncratic Risk	Tail Risk
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Green beta * NBER Recession	0.118**	0.302***	-0.254	-0.287**	0.029	-0.187*
	(2.46)	(4.14)	(-1.53)	(-1.99)	(0.30)	(-1.84)
Green beta	0.073***	0.118***	-0.089**	-0.058	-0.067**	-0.119*
	(4.98)	(2.97)	(-2.02)	(-1.58)	(-2.11)	(-1.91)
Log (size)	0.039***	-0.009	-0.133***	-0.083***	-0.100***	-0.127***
	(5.44)	(-0.75)	(-4.27)	(-3.25)	(-5.08)	(-2.98)
Fund age	-0.017***	-0.003	0.002	0.014**	-0.017***	0.023**
	(-8.71)	(-0.73)	(0.29)	(2.09)	(-3.18)	(1.99)
Lock-up period	-0.000	0.002	0.021**	0.016**	0.012**	0.018*
	(-0.27)	(0.90)	(2.43)	(2.35)	(2.05)	(1.71)
Management fee	0.195***	0.035	0.097	-0.110	0.284***	-0.010
	(6.12)	(0.66)	(0.81)	(-1.18)	(3.27)	(-0.06)
Incentive fee	0.006**	-0.004	-0.013	-0.024**	0.012*	-0.022
	(1.98)	(-0.75)	(-1.15)	(-2.54)	(1.66)	(-1.48)
High water mark	0.119**	0.079	0.166	0.154	0.104	0.240
	(2.10)	(1.21)	(0.83)	(0.97)	(0.78)	(0.93)
Leveraged	-0.000	-0.019	-0.043	-0.114	0.084	-0.215
	(-0.00)	(-0.47)	(-0.35)	(-1.15)	(1.05)	(-1.31)
Time FE	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES
Observations	66,841	66,841	66,841	66,841	66,841	66,841
R-squared	0.108	0.249	0.224	0.261	0.152	0.245

Panel B: Hedge Fund Performance and Risk During Climate-Specific Stress States

	Performance		Risk			
	Alpha	Excess Return	Total Risk	Systematic Risk	Idiosyncratic Risk	Tail Risk
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Green beta * Climate Sentiment	-0.001	0.008	-0.003	-0.002	-0.003**	-0.005
	(-1.09)	(1.44)	(-1.59)	(-0.86)	(-2.09)	(-1.29)
Green beta	0.092***	-0.015	-0.034	-0.026	-0.010	-0.037
	(4.25)	(-0.15)	(-0.60)	(-0.47)	(-0.24)	(-0.41)
Log (size)	0.039***	-0.008	-0.133***	-0.083***	-0.101***	-0.127***
	(5.44)	(-0.72)	(-4.28)	(-3.25)	(-5.10)	(-2.99)
Fund age	-0.017***	-0.003	0.002	0.014**	-0.017***	0.023**
	(-8.70)	(-0.76)	(0.30)	(2.09)	(-3.16)	(2.00)
Lock-up period	-0.000	0.003	0.021**	0.016**	0.012**	0.018*
	(-0.27)	(0.93)	(2.43)	(2.34)	(2.05)	(1.70)
Management fee	0.195***	0.034	0.098	-0.110	0.284***	-0.010
	(6.12)	(0.65)	(0.81)	(-1.18)	(3.27)	(-0.06)
Incentive fee	0.006**	-0.004	-0.013	-0.024**	0.012*	-0.022
	(1.98)	(-0.72)	(-1.16)	(-2.54)	(1.65)	(-1.48)
High water mark	0.120**	0.078	0.166	0.154	0.105	0.241
	(2.11)	(1.18)	(0.83)	(0.96)	(0.78)	(0.94)
Leveraged	-0.000	-0.019	-0.043	-0.114	0.084	-0.214
	(-0.00)	(-0.48)	(-0.35)	(-1.15)	(1.05)	(-1.31)
Time FE	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES
Observations	66,841	66,841	66,841	66,841	66,841	66,841
R-squared	0.108	0.249	0.224	0.261	0.152	0.245

This table examines hedge fund performance and risk during adverse states. Panel A tests hedge fund performance and risk during market downturns proxied by the NBER recession indicator. *NBER Recession* is a dummy variable that equals one for recession periods based on the US Business Cycle Expansions and Contractions data from the National Bureau of Economic Research (NBER), and zero otherwise. Panel B reports hedge fund performance and risk during climate-specific stress states. *Climate Sentiment* is the climate news sentiment index calculated as the correlation between the text content of *The Wall Street Journal* (WSJ) and a fixed climate change vocabulary (following Engle et al. (2020)). Green beta is defined in equation (1). The dependent variables in Columns (1) and (2) are alpha and excess return, respectively. The dependent variables in Columns (3)–(6) are total risk, systematic risk, idiosyncratic risk, and tail risk. Control variables include the natural logarithm of fund size, fund age, lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A4. Hedge Fund Performance and Risk across Strategies

Panel A: Hedge Fund Performance-Portfolio Sorts across Strategies

Green beta	Long-short		Event-driven		Global macro		Relative value	
	Alpha	Return	Alpha	Return	Alpha	Return	Alpha	Return
Rank 5	0.228	0.804	0.351	0.921	0.148	0.120	0.416	0.577
Rank 4	0.104	0.602	0.272	0.433	0.181	0.308	0.368	0.362
Rank 3	0.074	0.483	0.311	0.383	0.110	0.253	0.311	0.359
Rank 2	0.040	0.523	0.240	0.326	0.048	0.382	0.210	0.276
Rank 1	0.010	0.423	0.188	0.519	-0.194	0.101	0.036	0.336
R5-R1	0.218***	0.382***	0.163***	0.402***	0.342***	0.019	0.380***	0.241

Panel B: Hedge Fund Performance Regressions across Strategies

VARIABLES	Long-short		Event-driven		Global macro		Relative value	
	Alpha	Return	Alpha	Return	Alpha	Return	Alpha	Return
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Green beta	0.061***	0.140***	0.039	0.094**	0.116**	0.011	0.080*	0.036
	(3.40)	(7.22)	(1.14)	(2.42)	(2.32)	(0.26)	(1.94)	(0.92)
Log (size)	0.043***	-0.006	0.022	-0.005	0.053***	0.005	0.052***	-0.020
	(3.55)	(-0.46)	(1.08)	(-0.23)	(3.34)	(0.34)	(3.20)	(-1.20)
Fund age	-0.019***	-0.002	-0.014***	-0.014***	-0.010*	-0.002	-0.035***	-0.024**
	(-6.67)	(-0.54)	(-2.83)	(-3.11)	(-1.80)	(-0.43)	(-6.03)	(-2.55)
Lock-up period	-0.003	0.001	0.001	0.005	-0.001	0.024*	0.019***	0.018***
	(-1.09)	(0.28)	(0.32)	(1.37)	(-0.10)	(1.91)	(3.94)	(3.32)
Management fee	0.282***	0.115*	0.032	-0.040	0.172**	0.023	0.234***	0.223**
	(5.54)	(1.88)	(0.37)	(-0.45)	(2.58)	(0.35)	(3.41)	(2.59)
Incentive fee	0.005	-0.009	0.006	-0.005	0.011*	-0.009	-0.004	-0.011
	(0.95)	(-1.30)	(0.38)	(-0.28)	(1.72)	(-1.16)	(-0.55)	(-1.48)
High water mark	0.220**	0.182*	0.070	0.216	0.000	0.096	0.086	0.006
	(2.38)	(1.69)	(0.25)	(0.89)	(0.00)	(0.74)	(0.67)	(0.05)
Leveraged	0.004	0.009	-0.013	-0.000	-0.128	-0.059	0.031	0.051
	(0.11)	(0.19)	(-0.21)	(-0.01)	(-1.14)	(-0.49)	(0.39)	(0.65)
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	37,709	37,709	9,059	9,059	6,372	6,372	6,215	6,215
R-squared	0.099	0.314	0.140	0.322	0.119	0.132	0.283	0.294

Panel C. Hedge Fund Risk-Portfolio Sorts across Strategies

Green beta	Long-short	Event-driven	Global macro	Relative value
	Total risk			
Rank 5 (highest)	4.023	3.371	3.163	2.099
Rank 4	3.012	2.023	2.288	1.462
Rank 3	2.860	1.631	2.104	1.306
Rank 2	3.108	2.154	2.372	1.720
Rank 1 (lowest)	4.198	3.458	3.128	3.670
Highest-Lowest	-0.175***	-0.087	0.035	-1.571***
	Systematic risk			
Rank 5 (highest)	3.081	2.388	2.170	1.317
Rank 4	2.412	1.536	1.685	1.027
Rank 3	2.346	1.250	1.626	1.006
Rank 2	2.573	1.699	1.820	1.286
Rank 1 (lowest)	3.174	2.662	2.216	2.686
Highest-Lowest	-0.093***	-0.274***	-0.044	-1.369***
	Idiosyncratic risk			
Rank 5 (highest)	2.432	2.219	2.227	1.564
Rank 4	1.657	1.223	1.477	0.973
Rank 3	1.482	0.968	1.237	0.759
Rank 2	1.569	1.223	1.418	1.060
Rank 1 (lowest)	2.540	2.091	2.119	2.419
Highest-Lowest	-0.108***	0.128***	0.108***	-0.855***
	Tail risk			
Rank 5 (highest)	6.838	6.056	5.875	4.076
Rank 4	5.470	3.823	4.301	2.890
Rank 3	5.193	2.995	4.077	2.573
Rank 2	5.612	4.233	4.627	3.278
Rank 1 (lowest)	6.792	6.438	6.380	6.332
Highest-Lowest	0.046	-0.382***	-0.505***	-2.256***

Panel D. Hedge Fund Risk Regressions across Strategies

Total risk	Long-short	Event-driven	Global macro	Relative value
	(1)	(3)	(5)	(7)
Green beta	0.033	-0.274***	0.028	-0.755***
	(0.82)	(-3.08)	(0.32)	(-7.94)
Controls	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	37,709	9,059	6,372	6,215
R-squared	0.184	0.227	0.152	0.415
Systematic risk	Long-short	Event-driven	Global macro	Relative value
	(1)	(3)	(5)	(7)
Green beta	0.036	-0.229***	0.013	-0.617***
	(0.86)	(-2.71)	(0.22)	(-7.22)
Controls	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	37,709	9,059	6,372	6,215
R-squared	0.204	0.212	0.184	0.441
Idiosyncratic risk	Long-short	Event-driven	Global macro	Relative value
	(1)	(3)	(5)	(7)
Green beta	-0.003	-0.161**	0.037	-0.600***
	(-0.08)	(-2.52)	(0.50)	(-7.59)
Controls	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	37,709	9,059	6,372	6,215
R-squared	0.086	0.115	0.180	0.434
Tail risk	Long-short	Event-driven	Global macro	Relative value
	(1)	(3)	(5)	(7)
Green beta	0.091	-0.512**	-0.071	-1.239***
	(1.44)	(-2.53)	(-0.34)	(-6.90)
Controls	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	37,709	9,059	6,372	6,215
R-squared	0.184	0.227	0.152	0.415

Panel A reports the univariate analysis of fund performance and fund green beta by different strategies. Each month, funds are sorted into five quintiles based on fund green beta. Fund green beta increases monotonically from the lowest quintile (Rank 1) to the highest quintile (Rank 5). Panel B reports results from the regression of fund performance on fund green beta and other characteristics across strategies. Panel C reports the univariate analysis of fund risk and fund green beta across strategies. Fund risk include: total risk, systematic risk, idiosyncratic risk, and tail risk. Panel D reports results from the regression of fund risk on fund green beta and other characteristics across strategies. All regressions include the following control variables: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, and a dummy variable for funds with leverage. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A5. Coefficient Difference Test

Panel A: Comparison of Coefficients from Panel A of Table 8

	Coefficient			Coefficient Difference	*p*-value
	Directional	Semi-Directional	Non-Directional		
Alpha	0.175***	0.059***		0.116***	0.0067
	0.175***		0.112***	0.063	0.2438
		0.059***	0.112***	0.053	0.1927
Return	0.102**	0.133***		-0.031	0.5020
	0.102**		0.056	0.046	0.4402
		0.133***	0.056	0.077*	0.0889

Panel B: Comparison of Coefficients from Panel B of Table 8

	Coefficient			Coefficient Difference	*p*-value
	Directional	Semi-Directional	Non-Directional		
Total risk	-0.101	-0.029		-0.072	0.4596
	-0.101		-0.770***	0.669***	0
		-0.029	-0.770***	0.741***	0
Systematic risk	-0.085	-0.012		-0.073	0.2819
	-0.085		-0.563***	0.478***	0
		-0.012	-0.563***	0.551***	0
Idiosyncratic risk	-0.055	-0.028		-0.027	0.7132
	-0.055		-0.528***	0.473***	0
		-0.028	-0.528***	0.500***	0
Tail risk	-0.224	-0.007		-0.217	0.1974
	-0.224		-1.206***	0.982***	0
		-0.007	-1.206***	1.199***	0

Panel C: Comparison of Coefficients from Panel C of Table 8

	Coefficient			Coefficient Difference	*p*-value
	Directional	Semi-Directional	Non-Directional		
Equal-weighted green beta	0.327***	0.029		0.298***	0
	0.327***		0.075	0.252**	0.0104
		0.029	0.075	-0.046	0.6231
Value-weighted green beta	0.293***	0.024		0.269***	0
	0.293***		0.083	0.210**	0.0351
		0.024	0.083	-0.059	0.6204

Panel D: Comparison of Coefficients from Panel D of Table 8

	Coefficient			Coefficient Difference	*p*-value
	Directional	Semi-Directional	Non-Directional		
Green beta	-0.038	0.157***		-0.195	0.1505
	-0.038		0.032	-0.070	0.6109
		0.157***	0.032	0.125	0.1433

This table reports pairwise coefficient-difference tests across the three broad hedge fund strategy groups: Directional, Semi-Directional, and Non-Directional. For each outcome, we first report the estimated coefficient on green beta from the corresponding regressions in Table 8 and then test whether the coefficient differences across strategy groups are statistically significant using SUEST-based Wald tests. Panel A examines fund performance, Panel B examines fund risk, Panel C examines stock-picking skills, and Panel D examines green factor-timing skills. The reported *p*-values correspond to the null hypothesis that the coefficients are equal across the two strategy groups being compared. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A6. Hedge Fund Flow and Performance Sensitivity

	Flow			
	(1)	(2)	(3)	(4)
Green fund*Return	0.006	0.030		
	(0.07)	(0.33)		
Green fund*Alpha			0.172	0.156
			(0.64)	(0.58)
Green fund	0.480***	0.461***	0.349**	0.353**
	(2.73)	(2.64)	(2.07)	(2.09)
Return	0.607***	0.628***		
	(8.82)	(8.81)		
Alpha			2.470***	2.513***
			(11.38)	(11.36)
log (size)	-0.364***	-0.359***	-0.442***	-0.435***
	(-6.79)	(-6.70)	(-7.96)	(-7.84)
Fund age	-0.153***	-0.156***	-0.116***	-0.119***
	(-10.98)	(-11.19)	(-8.13)	(-8.37)
Lock-up period	0.017	0.018	0.019	0.019
	(1.40)	(1.44)	(1.45)	(1.45)
Management fee	0.068	0.101	-0.404*	-0.367*
	(0.31)	(0.46)	(-1.83)	(-1.66)
Incentive fee	-0.012	-0.010	-0.034	-0.034
	(-0.56)	(-0.48)	(-1.62)	(-1.60)
High water mark	0.196	0.194	0.030	0.058
	(0.55)	(0.55)	(0.08)	(0.16)
Leveraged	0.005	0.052	-0.002	0.038
	(0.03)	(0.26)	(-0.01)	(0.19)
Past flow	0.282***	0.283***	0.263***	0.263***
	(22.27)	(22.17)	(20.84)	(20.70)
Time FE	YES	NO	YES	NO
Strategy FE	YES	NO	YES	NO
Strategy-time FE	No	YES	NO	YES
Observations	22,774	22,774	22,774	22,774
R-squared	0.122	0.141	0.131	0.150

This table examines whether hedge fund greenness affects the sensitivity of fund flows to performance. The dependent variable is quarterly fund flow, defined as the percentage change in total net assets (TNA) after adjusting for the fund's total return, as described in Equation (9). The key variables of interest are the interactions between Green fund and fund performance. Green fund is a dummy variable equal to one if the fund's green beta is above the median in the previous quarter and zero otherwise. Fund performance is measured by fund return in Columns (1) and (2) and by fund alpha in Columns (3) and (4). Control variables include: the natural logarithm of fund size, fund age, lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, a dummy variable for funds with leverage, and fund flow in previous quarter. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A7. Effects of Hedge Funds Joining the UNPRI on Green Investing and Fund Flows

Panel A: Hedge Fund Management Firm Green Beta before and after Joining the UNPRI

	Green Beta (equally-weighted)	Green Beta (value-weighted)
	(1)	(2)
UNPRI*Post	0.107*	0.136*
	(1.67)	(1.88)
Controls	YES	YES
Year FE	YES	YES
Hedge fund firm FE	YES	YES
Observations	3,366	2,774
R-squared	0.0421	0.0211

Panel B: Hedge Fund Management Firm Flows before and after Joining the UNPRI

	Firm flow (equally-weighted)	Firm flow (value-weighted)
	(1)	(2)
UNPRI *Post	0.144**	0.170*
	(2.21)	(1.81)
Controls	YES	YES
Year FE	YES	YES
Hedge fund firm FE	YES	YES
Observations	2,225	2,229
R-squared	0.0876	0.0769

Panel A reports results from the difference-in-difference (DiD) regression examining hedge fund management firm green beta before and after joining the UNPRI. The dependent variables are hedge fund management firm green beta, which is aggregated from individual funds within the same management firm. In model (1), all variables are aggregated at the hedge fund management firm level using equal-weighted averages. In model (2), all variables are aggregated at the firm level using value-weighted averages. UNPRI takes a value of 1 if the hedge fund management firm has signed the UNPRI and 0 otherwise. Post takes a value of 0 before the firm signs the UNPRI and 1 post-signing. Panel B reports results from the DiD regression examining hedge fund management firm flows before and after joining the UNPRI. The dependent variables are hedge fund management firm annual flows, which are aggregated from individual funds within the same management firm. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A8. Hedge Fund Carbon Risk and Fund Performance and Risk

	Performance		Risk	
	Alpha	Excess return	Total risk	Tail risk
	(1)	(2)	(3)	(4)
Carbon risk score	-0.006**	-0.003*	0.019***	0.026***
	(-2.13)	(-1.71)	(3.86)	(2.66)
Log (size)	0.048***	0.038***	-0.042*	-0.078*
	(5.83)	(4.38)	(-1.73)	(-1.66)
Fund age	-0.015***	0.002	0.008	0.021
	(-6.60)	(0.99)	(1.24)	(1.64)
Lock up period	0.000	0.001	0.008	0.012
	(0.07)	(0.52)	(1.19)	(1.03)
Management fee	0.204***	0.032	-0.022	-0.092
	(5.70)	(0.87)	(-0.22)	(-0.48)
Incentive fee	0.006**	-0.004	-0.019**	-0.035**
	(2.13)	(-1.29)	(-2.04)	(-1.99)
High water mark	0.080	-0.001	0.195	0.365
	(1.48)	(-0.02)	(1.16)	(1.16)
Leveraged	-0.030	-0.040	-0.048	-0.179
	(-0.96)	(-1.16)	(-0.49)	(-0.97)
Time FE	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES
Observations	48,295	53,485	48,295	48,295
R-squared	0.1048	0.2822	0.2503	0.2413

This table examines the relationship between hedge fund greenness and fund performance and risk by replacing the fund's green beta with its carbon risk score. We first compute a hedge fund management firm–level carbon risk score as the value-weighted average of the carbon risk scores of its 13F stock holdings. We then assign this firm-level score to all funds managed by the same firm. The regression includes the following control variables: the natural logarithm of fund size, fund age, fund lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with high water mark, and a dummy variable for funds with leverage. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A9. Alternative Hedge Fund Green Beta and Fund Performance

Panel A: Alternative Hedge Fund Green Beta and Fund Alpha

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
β_G (7f + RMW)	0.070***	0.069***										
	(5.19)	(5.13)										
β_G (7f + CMA)			0.067***	0.065***								
			(4.96)	(4.83)								
β_G (7f + MOM)					0.060***	0.059***						
					(4.79)	(4.61)						
β_G (7f + HML)							0.074***	0.073***				
							(5.67)	(5.53)				
β_G (7f + All 4 factors)									0.048***	0.049***		
									(4.41)	(4.35)		
β_G (9f)											0.030**	0.029**
											(2.43)	(2.25)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Strategy FE	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Strategy-time FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318
R-squared	0.109	0.134	0.109	0.132	0.108	0.131	0.112	0.135	0.107	0.131	0.101	0.126

Panel B: Alternative Hedge Fund Green Beta and Fund Excess Return

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
β_G (7f + RMW)	0.154***	0.153***										
	(10.06)	(9.92)										
β_G (7f + CMA)			0.141***	0.142***								
			(9.40)	(9.24)								
β_G (7f + MOM)					0.144***	0.137***						
					(10.20)	(9.81)						
β_G (7f + HML)							0.113***	0.113***				
							(7.57)	(7.48)				
β_G (7f + All 4 factors)									0.096***	0.095***		
									(7.25)	(7.08)		
β_G (9f)											0.120***	0.114***
											(9.23)	(8.71)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Strategy FE	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Strategy-time FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318
R-squared	0.252	0.309	0.251	0.308	0.252	0.308	0.251	0.308	0.251	0.131	0.251	0.308

This table reports the relationship between hedge fund greenness and both fund alpha and excess return, using alternative measures of the fund's green beta. Panel A reports the results of fund alpha and Panel B reports the results of fund excess return. In Columns (1) and (2), the green beta is estimated using Fung and Hsieh's (2004) seven-factor model, as outlined in Equation (1), plus the Fama–French profitability factor (RMW). In Columns (3) and (4), the green beta is estimated using the same seven-factor model plus the Fama–French investment factor (CMA). In Columns (5) and (6), the green beta is estimated using the seven-factor model plus the Fama–French–Carhart momentum factor (MOM). In Columns (7) and (8), the green beta is estimated using the seven-factor model plus the Fama–French value factor (HML). In Columns (9) and (10), the green beta is estimated using the seven-factor model plus all of the above factors. Finally, in Columns (11) and (12), the green beta is estimated using the Chen et al. (2024) nine-factor model. Control variables include: the natural logarithm of fund size, fund age, lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, a dummy variable for funds with leverage, and fund flow in previous quarter. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A10. Alternative Hedge Fund Green Beta and Fund Risk

Panel A: Alternative Hedge Fund Green Beta and Fund Total Risk

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
β_G (7f + RMW)	-0.110***	-0.112***										
	(-3.50)	(-3.46)										
β_G (7f + CMA)			-0.044	-0.044								
			(-1.38)	(-1.33)								
β_G (7f + MOM)					-0.050*	-0.053*						
					(-1.66)	(-1.70)						
β_G (7f + HML)							-0.108***	-0.112***				
							(-3.15)	(-3.16)				
β_G (7f + All 4 factors)									-0.053**	-0.056**		
									(-2.10)	(-2.15)		
β_G (9f)											-0.089***	-0.092***
											(-3.33)	(-3.34)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Strategy FE	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Strategy-time FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318
R-squared	0.252	0.265	0.247	0.259	0.247	0.260	0.252	0.265	0.252	0.265	0.251	0.308

Panel B: Alternative Hedge Fund Green Beta and Fund Tail Risk

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
β_G (7f + RMW)	-0.172***	-0.171***										
	(-3.20)	(-3.08)										
β_G (7f + CMA)			-0.098*	-0.092*								
			(-1.87)	(-1.71)								
β_G (7f + MOM)					-0.082*	-0.083						
					(-1.65)	(-1.63)						
β_G (7f + HML)							-0.191***	-0.195***				
							(-3.64)	(-3.58)				
β_G (7f + All 4 factors)									-0.094**	-0.099**		
									(-2.43)	(-2.48)		
β_G (9f)											-0.186***	-0.193***
											(-4.11)	(-4.10)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Strategy FE	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Strategy-time FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318	68,318
R-squared	0.252	0.265	0.247	0.259	0.247	0.260	0.252	0.265	0.252	0.265	0.249	0.270

This table reports the results on the relationship between hedge fund greenness and both fund total risk and tail risk, using alternative measures of the fund's green beta. Panel A reports results for fund total risk, and Panel B reports results for fund tail risk. In Columns (1) and (2), the green beta is estimated using Fung and Hsieh's (2004) seven-factor model, as outlined in Equation (1), plus the Fama–French profitability factor (RMW). In Columns (3) and (4), the green beta is estimated using the same seven-factor model plus the Fama–French investment factor (CMA). In Columns (5) and (6), the green beta is estimated using the seven-factor model plus the Fama–French–Carhart momentum factor (MOM). In Columns (7) and (8), the green beta is estimated using the seven-factor model plus the Fama–French value factor (HML). In Columns (9) and (10), the green beta is estimated using the seven-factor model plus all of the above factors. Finally, in Columns (11) and (12), the green beta is estimated using Chen et al. (2024) nine-factor model. Control variables include: the natural logarithm of fund size, fund age, lock-up period (in months), management fee (%), incentive fee (%), a dummy variable for funds with a high water mark, a dummy variable for funds with leverage, and fund flow in previous quarter. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A11. Hedge Fund Green Beta and Fund Performance

Panel A: Hedge Fund Performance Sorted by Fund Green Beta

Green beta	Alpha	Excess Return
Rank 5 (highest)	0.246	0.725
Rank 4	0.171	0.479
Rank 3	0.190	0.405
Rank 2	0.130	0.411
Rank 1 (lowest)	0.055	0.395
Highest-Lowest	0.191***	0.330***

Panel B: Hedge Fund Green Beta and Fund Performance

	Alpha	Excess Return
	(1)	(2)
Green beta	0.063***	0.120***
	(4.13)	(7.58)
Log (size)	0.037***	-0.011
	(4.43)	(-1.22)
Fund age	-0.016***	-0.000
	(-8.01)	(-0.16)
Lock-up period	-0.000	0.002
	(-0.03)	(0.89)
Management fee	0.212***	0.053
	(6.22)	(1.41)
Incentive fee	0.006*	-0.005
	(1.92)	(-1.39)
High water mark	0.125**	0.082
	(2.29)	(1.28)
Leveraged	-0.003	-0.036
	(-0.10)	(-1.13)
Time FE	YES	YES
Strategy FE	YES	YES
Observations	61,201	61,201
R-squared	0.104	0.253

This table re-estimates the hedge fund green beta and fund performance analysis in Table 3 using a more conservative sample restriction that requires funds to have at least $10 million in monthly AUM over the sample period, instead of the $1 million monthly AUM cutoff used in the baseline analysis. All variables, control variables, fixed effects, and standard-error clustering follow the baseline specification in Table 3. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A12. Hedge Fund Green Beta and Fund Risk

	Total Risk	Systematic Risk	Idiosyncratic Risk	Tail Risk
	(1)	(2)	(3)	(4)
Green beta	-0.106**	-0.077***	-0.068**	-0.103*
	(-2.58)	(-2.62)	(-2.15)	(-1.74)
Log (size)	-0.142***	-0.085***	-0.110***	-0.144***
	(-4.31)	(-3.28)	(-4.75)	(-2.89)
Fund age	0.006	0.017**	-0.015***	0.023**
	(0.72)	(2.58)	(-2.81)	(1.99)
Lock-up period	0.022***	0.016**	0.013**	0.021*
	(2.59)	(2.46)	(2.25)	(1.94)
Management fee	0.133	-0.095	0.320***	-0.004
	(1.03)	(-0.98)	(3.37)	(-0.02)
Incentive fee	-0.018	-0.026***	0.008	-0.030*
	(-1.60)	(-2.89)	(1.02)	(-1.94)
High water mark	0.150	0.131	0.107	0.309
	(0.77)	(0.85)	(0.80)	(1.19)
Leveraged	-0.041	-0.119	0.092	-0.206
	(-0.34)	(-1.23)	(1.13)	(-1.23)
Time FE	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES
Observations	61,201	61,201	61,201	61,201
R-squared	0.228	0.269	0.151	0.244

This table re-estimates the hedge fund green beta and fund risk analysis in Table 4 using a more conservative sample restriction that requires funds to have at least $10 million in monthly AUM over the sample period, instead of the $1 million monthly AUM cutoff used in the baseline analysis. All variables, control variables, fixed effects, and standard-error clustering follow the baseline specification in Table 4. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.

Table A13. Hedge Fund Performance and Risk During Adverse States

Panel A: Hedge Fund Performance and Risk During Market Downturns

	Performance		Risk			
	Alpha	Excess Return	Total Risk	Systematic Risk	Idiosyncratic Risk	Tail Risk
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Green beta * Market crash	0.146***	0.215***	-0.021	-0.103**	0.169	-0.241***
	(2.69)	(3.53)	(-0.12)	(-2.40)	(1.56)	(-6.71)
Green beta	0.062***	0.119***	-0.105***	-0.077**	-0.068**	-0.102
	(4.09)	(2.92)	(-2.58)	(-2.42)	(-2.17)	(-1.57)
Log (size)	0.037***	-0.011	-0.142***	-0.085***	-0.110***	-0.144***
	(4.43)	(-0.85)	(-4.31)	(-3.29)	(-4.75)	(-2.88)
Fund age	-0.016***	-0.000	0.006	0.017**	-0.015***	0.023*
	(-8.01)	(-0.08)	(0.72)	(2.55)	(-2.81)	(1.94)
Lock-up period	-0.000	0.002	0.022***	0.016**	0.013**	0.021*
	(-0.04)	(0.67)	(2.59)	(2.46)	(2.25)	(1.94)
Management fee	0.212***	0.053	0.133	-0.095	0.320***	-0.004
	(6.22)	(1.01)	(1.03)	(-0.97)	(3.37)	(-0.02)
Incentive fee	0.006*	-0.005	-0.018	-0.026***	0.008	-0.030*
	(1.92)	(-0.92)	(-1.60)	(-2.88)	(1.02)	(-1.94)
High water mark	0.125**	0.081	0.150	0.131	0.107	0.310
	(2.29)	(1.29)	(0.77)	(0.85)	(0.80)	(1.19)
Leveraged	-0.003	-0.036	-0.041	-0.119	0.092	-0.206
	(-0.10)	(-0.87)	(-0.34)	(-1.23)	(1.14)	(-1.22)
Time FE	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES
Observations	61,201	61,201	61,201	61,201	61,201	61,201
R-squared	0.104	0.253	0.228	0.269	0.151	0.244

Panel B: Hedge Fund Performance and Risk During Climate-Specific Stress States

	Performance		Risk			
	Alpha	Excess Return	Total Risk	Systematic Risk	Idiosyncratic Risk	Tail Risk
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Green beta * High CPU	0.056**	0.169**	-0.188***	-0.134**	-0.113**	-0.122
	(2.48)	(2.01)	(-2.77)	(-2.18)	(-2.56)	(-1.42)
Green beta	0.050***	0.079	-0.061	-0.045	-0.041	-0.074
	(3.04)	(1.61)	(-1.62)	(-1.51)	(-1.40)	(-1.09)
Log (size)	0.037***	-0.011	-0.142***	-0.085***	-0.109***	-0.143***
	(4.42)	(-0.89)	(-4.31)	(-3.29)	(-4.75)	(-2.87)
Fund age	-0.016***	-0.000	0.006	0.017**	-0.015***	0.023*
	(-8.02)	(-0.09)	(0.73)	(2.55)	(-2.81)	(1.94)
Lock-up period	-0.000	0.002	0.022***	0.017**	0.013**	0.021*
	(-0.08)	(0.57)	(2.62)	(2.48)	(2.28)	(1.96)
Management fee	0.212***	0.051	0.136	-0.094	0.322***	-0.002
	(6.21)	(0.98)	(1.05)	(-0.95)	(3.39)	(-0.01)
Incentive fee	0.006*	-0.005	-0.018	-0.026***	0.008	-0.030*
	(1.92)	(-0.92)	(-1.61)	(-2.89)	(1.02)	(-1.94)
High water mark	0.124**	0.077	0.155	0.135	0.110	0.313
	(2.27)	(1.23)	(0.80)	(0.87)	(0.83)	(1.21)
Leveraged	-0.003	-0.036	-0.041	-0.119	0.092	-0.206
	(-0.10)	(-0.88)	(-0.34)	(-1.23)	(1.14)	(-1.22)
Time FE	YES	YES	YES	YES	YES	YES
Strategy FE	YES	YES	YES	YES	YES	YES
Observations	61,201	61,201	61,201	61,201	61,201	61,201
R-squared	0.105	0.254	0.230	0.270	0.152	0.244

This table re-estimates the adverse-state performance and risk analysis in Table 5 using a more conservative sample restriction that requires funds to have at least $10 million in monthly AUM over the sample period, instead of the $1 million monthly AUM cutoff used in the baseline analysis. All variables, control variables, fixed effects, and standard-error clustering follow the baseline specification in Table 5. The t-statistics are reported in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), or 10% (*) level.