

Do Brown Backgrounds Talk? The Impact of Fund Managers' Carbon Background on
Carbon emissions

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Abstract

This paper investigates whether mutual fund managers' prior work experience in carbon-intensive industries influences the environmental profile of their investment portfolios. Drawing on work socialization and imprinting theories, we argue that such experiences may shape enduring preferences and attitudes toward carbon emissions. Using panel data 1,203 fund managers and 2,271 U.S. firms from 2008 to 2023, we find that managers with carbon-intensive industry backgrounds are significantly less likely to hold high-emission firms, resulting in lower Scope 1, Scope 2 (location-based), and Scope 3 (upstream) portfolio carbon intensities both in fund and firm level. Further analysis reveals that these managers reduce emissions both through firm selection and post-investment monitoring. The aversion is especially pronounced toward firms with carbon-intensive supply chains, consistent with an experience-driven sensitivity to operational and reputational risks associated with upstream emissions. Our findings suggest that professional background plays a critical role in shaping sustainable investment outcomes.

Keywords: Fund Manager Experience; Carbon Emissions; ESG Investing; Sustainable Finance; Greenwashing; Mutual Funds

JEL Codes: G11, G23, M14, Q56, D91

1 Introduction

Work experience and its influence on productivity have long been important topic in human capital theory (e.g., Pyatt, 1966; Becker, 2009; Mincer, 1974). Building on these early studies, a growing literature has explored how investment managers' professional experiences influence their performance (Golec, 1996; Chevalier and Ellison, 1999; Greenwood and Nagel, 2009; Kempf et al., 2017). Most of these researches focus on on-the-job learning, emphasizing the role of experience accumulated during fund managers' careers within the investment industry through a process of learning by doing. While on-the-job experience within the investment industry is a key factor of fund managers' human capital, many managers also bring prior work experience from other sectors. Work socialization theory (Van Maanen and Schein, 1977; Feldman, 1981) and career imprinting theory (Higgins, 2005) point that such experience may leave enduring effects on how they perceive risk, interpret information, and formulate judgments. The economics literature suggests that these imprints may go beyond technical expertise, they embed norms, routines, and moral frameworks from earlier work environments that may persist over time, even after transitioning into different industries. For instance, Neal (1995) finds that workers continue to receive benefits on their industry-specific experience even after transitioning into different industries.

Building on these insights, a number of empirical studies begin to explore how sector-specific experience outside the financial industry continues to shape investment preferences and behaviors. For example, Pool et al. (2012) and Ding and Wermers (2012) find that mutual fund managers tend to allocate more capital to sectors in which they previously worked, often maintaining this preference regardless of performance. Cici et al. (2018) further demonstrate that such overweighting behavior does not necessarily reflect informational advantage, but instead because of behavioral familiarity. These findings suggest that the imprint of past work environments extends into new decision-making contexts, influencing how fund managers evaluate and engage with firms across industries. A natural question arises: Do fund managers with backgrounds in high-carbon industries also exhibit a similar sectoral preference after transitioning into the asset management profession? According to career imprinting theory (Higgins, 2005) and work socialization theory (Van Maanen & Schein, 1977), prior industry experience shapes cognitive frames, decision heuristics, and perceptions of what is "normal" or acceptable. In the case of carbon-intensive sectors, such as oil, gas, utilities, and heavy manufacturing, exposure to high-emissions operations may result in a higher tolerance for such

environmental externalities or even a positive perception of these business models due to their profitability or technical familiarity (Marquis & Huang, 2010; Suchman, 1995). As a result, these managers may continue investing with high-emission industries.

However, an alternative perspective based on past work experience challenge this prediction. Rather than reinforcing familiarity and preference, prior exposure to ethically problematic or environmentally harmful industries may instead produce long-term aversions toward similar situation. According to moral psychology and occupational imprinting theories, individuals internalize emotional and normative responses to the moral climate of their work environments (Ashforth et al., 2017). When these environments are marked by reputational risk, contested legitimacy, or regulatory scrutiny, as is often the case in carbon-intensive sectors, such exposure may lead to enduring discomfort or moral distancing in future roles (Roberts and Dowling, 2002). Lewis et al. (2014) find that executives with prior backgrounds in engineering or high-pollution sectors tend to avoid investing in or managing firms with poor environmental track records later in their careers. Therefore, fund managers who previously worked in carbon-intensive sectors may not exhibit preference toward high-emission firms, but rather avoid them, not out of regulatory pressure or performance logic, but due to internalized ethical concerns and reputational awareness. This perspective emphasizes the moral and affective legacies of industry experience, highlighting a second behavioral pathway through which past work environments can influence capital allocation.

Thus, while career imprinting theory suggests that fund managers with high-carbon industries experience may favor investments in high carbon industries' firms, moral psychology and occupational pressures could lead to different outcomes. The net impact of high carbon industry experience managers on the carbon emissions of their portfolio remains an empirical question. Using panel data of total 1203 mutual fund managers who actively managed open-end mutual funds¹ and carbon emissions in three scopes², we find that such experience is consistently linked with reduced carbon intensity, even after controlling for fund-

¹ Actively managed open-end funds are mutual funds in which fund managers make regular investment decisions to buy or sell assets with the goal of outperforming a benchmark index. These funds allow investors to enter or exit at the fund's net asset value (NAV), which is calculated at the end of each trading day.

² Carbon emissions are typically categorized into three scopes, as defined by the Greenhouse Gas Protocol. Scope 1 emissions are direct greenhouse gas emissions from sources owned or controlled by the company, such as fuel combustion and industrial processes. Scope 2 emissions are indirect emissions from the generation of purchased electricity, steam, heating, and cooling consumed by the reporting company. Scope 3 emissions encompass all other indirect emissions that occur in a company's value chain, including upstream and downstream activities such as purchased goods and services, business travel, and use of sold products. Scope 2 does not include Scope 1, and Scope 3 is a distinct category that does not subsume Scope 1 or Scope 2 emissions.

level characteristics and manager fixed effects. These results are further validated through a series of robustness checks using Morningstar's portfolio carbon risk metrics.

Having established that carbon-intensive experience predicts lower emissions, we then explore the mechanism through which these reductions occur. Specifically, we distinguish between two mechanisms: selection, whether managers avoid investing in high-emission firms and monitoring, whether managers actively engage with portfolio companies to reduce emissions. We test for selection by retaining only the first-year emissions data of invested firms and find that experienced managers do indeed screen for lower-carbon firms. We then assess monitoring by analysing support for ESG-related shareholder proposals and by tracking firm-level carbon emissions over time. Our results reveal a pattern of declining emissions post-holding indicating an active role in engagement and decarbonization.

We also examine whether this effect also impact on firm level to directly reduce the firm's carbon emissions and find fund managers with such experience have significantly negative relationship with specific firm carbon emissions in three scopes. We further test why fund managers even care about the scope 3 carbon emissions of invested firms, so we use the detailed scope 3 carbon emissions and find only the part of emissions which is related to supply chain but not include in scope 2 does have significantly relationship.

In order to solve the endogeneity problem, we adopt three ways to address concern. First, following Hainmueller (2012), we use Entropy balancing to remove all the observable differences in the treat group (i.e. mutual fund managers with carbon intensive industry experience) and control group (i.e. mutual fund managers without such experience), and then we employ a difference-in-differences (DID) estimator. After Entropy and DID, we use the average *Energy Consumption per capita* at the U.S. state level as an instrumental variable (IV) and estimate the regressions with two-stage least squares (2SLS). The results from these endogeneity tests confirm the main findings.

Our paper contributes to the growing literature on sustainable finance in several ways. First, we offer unique evidence on how fund managers' prior work experience outside the financial sector shapes ESG investment outcomes. Second, by differentiating between selection and monitoring mechanisms and validating results at both fund and firm levels, we provide a clearer understanding of how sustainability outcomes are achieved. Third, our results highlight

the importance of indirect emissions (Scope 2 and 3) in ESG analysis, where investor influence may be less visible but highly consequential.

For practitioners and policymakers, our findings suggest that fund manager expertise should be considered a critical factor into ESG strategy and performance evaluation. Allocating experienced managers to ESG-focused mandates may improve environmental outcomes, particularly when combined with robust engagement infrastructures. For future research, our study opens new avenues for exploring how managerial work experience influence investment practices, beyond traditional demographic indicators

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature and develops the research hypotheses. Section 3 describes the data, defines key variables, and presents the empirical model. Section 4 reports the main empirical results. Section 5 conducts a series of robustness checks to test the reliability of our findings. Section 6 investigates the mechanisms through which fund managers may influence the carbon emissions of portfolio firms, with a particular focus on Scope 3 emissions. Section 7 addresses potential endogeneity concerns and provides additional tests to reinforce causal interpretation. Section 8 concludes the paper. Section 9 offers policy implications for institutional investors and regulators, and discusses the study's limitations and directions for future research.

2 Literature Review and Hypothesis development

Work socialization theory argues that individuals' prior experiences shape their attitudes, values, and decision-making frameworks in meaningful ways (e.g., Van Maanen & Schein, 1977; Feldman, 1981). For example, the norms, routines, and strategic priorities entrenched in one's past industry exposure continue to influence behavior even after transitioning to a new position. Similarly, professional imprinting theory (Higgins, 2005) posits the working environment during the early stage of one's career has powerful influence, leaving lasting cognitive and moral imprints on the individual. These experiences are particularly influential in shaping how managers assess risk, respond to regulatory pressure, or evaluate corporate sustainability.

2.1 Fund Managers' Sector Familiarity and Behavioural Biases

A growing body of theoretical literature emphasizes that past work experience shows a long-term influence on how individuals perceive, interpret, and respond to information in future decision-making contexts. Previous experience shapes managerial preferences, heuristics, and values over time (Marquis and Tilcsik, 2013; Higgins, 2005). This concept is from Career Imprinting Theory, which posits that individuals' early career environments give enduring marks on their cognitive frames and behavioural tendencies, guiding how they approach subsequent professional roles, even in different industries or positions.

For fund management, this means that managers' investment decisions may reflect the norms, logics, and priorities of the industries where they previously worked. For example, someone with experience in a carbon-intensive sector like oil and gas or heavy manufacturing may have developed a particular familiarity with firms with high-emission environments, or become desensitized to the associated externalities. These experiential imprints are not mainly associated with greater expertise, but with a view shaped by exposure to certain business models, regulatory environments, and stakeholder expectations (Marquis and Huang, 2010).

Socialization theory further suggests that workplace environments create long-term norms and behavioural patterns, which persist even when individuals transition to new positions (Van Maanen & Schein, 1977; Feldman, 1981). This means that prior exposure to emission-intensive operations may lead to a tolerance of high emissions in future investments. Moreover, path dependence also plays a role in investment behaviour. Van Nieuwerburgh and Veldkamp (2009) argue that investors tend to concentrate on sectors they are familiar with, not because of superior insight, but because of inertia and perceived information familiarity. This reinforces a behavioural tendency to maintain existing mental models, particularly under uncertainty.

Empirical studies have also investigated the relationship between managers' past work experience and fund managers' investment behaviour and providing supporting evidence. For example, Bradley et al. (2017) show that financial analysts with industry experience produce significantly more optimistic forecasts for firms in their former sectors. Some other studies also show that industry familiarity leads to persistent portfolio preference, regardless of whether those allocations create higher returns. For example, Pool et al. (2012) find that mutual fund managers tend to allocate 4–6% more capital to sectors in which they previously worked. Ding

and Wermers (2012) further demonstrate that non-financial industry experience induces strong preference toward those sectors, particularly when the manager had a long position in the prior industry, which suggest deep-seated preferences. Similarly, Cici et al. (2018) argue that the overweighting of familiar industries does not from alpha-generating insight, as such positions typically yield no abnormal returns after adjusting for risk. Instead, these choices reflect non-performance-related behavioural biases as overconfidence. Kempf et al. (2017) also show that industry-experienced managers trade 23% more intensively in their familiar sectors, but only achieve slightly higher performance (0.5% returns), which may be offset by increased transaction costs. Bender et al. (2022) investigate that the influence of prior industry knowledge is stronger during periods of sector-specific uncertainty, suggesting that managers dependent on past experience more during unfamiliar situations.

While prior research demonstrates that fund managers exhibit persistent preferences for industries in which they have prior work experience (Pool et al., 2012; Ding & Wermers, 2012; Kempf et al., 2017), the implications of such biases for environmental, social, and governance (ESG) outcomes needs more research. Given that career imprinting and socialization processes shape managers' cognitive frames (Marquis & Tilcsik, 2013; Van Maanen & Schein, 1979), those with backgrounds in carbon-intensive industries (e.g., oil & gas, mining, or heavy manufacturing) may develop a view of high-emission business models, leading to a greater propensity to invest in firms in high-emissions industries. This tendency can be reinforced by cognitive legitimacy where individuals perceive familiar practices as more acceptable (Suchman, 1995; Bitektine & Haack, 2015).

Based on the above literature, it is reasonable we argue that fund managers with prior employment in carbon-intensive industries will exhibit a larger capital allocation to invest in high-emission firms, resulting in portfolios with high carbon emissions. In addition, since managers from pollutive sectors are socialized into operational and regulatory norms that tolerate higher emissions (Feldman, 1981; Marquis & Huang, 2010), they may perceive such firms as less risky or more viable, even when ESG-conscious alternatives exist. Therefore, our first hypothesis as follows.

H1: Fund managers with prior work experience in dirty industries are more likely to construct portfolios with carbon intensive industries with higher carbon emissions

2.2 Industry Insight

While familiarity bias is often cited as a reason why fund managers tend to allocate more capital to industries where they previously worked, an alternative explanation posits that certain professional experiences, particularly in controversial or high-impact sectors, may lead to long-term aversions rather than preference. For carbon-intensive industries, previous exposure may lead a strong preference to avoid such sectors because of emotional, moral, or reputational associations shaped during prior employment.

In contrast to the view that industry-specific experience leads fund managers to overweight familiar sectors (familiarity bias), an emerging stream of research suggests that past exposure to carbon-intensive industries may, in fact, lead to long-term avoidance behaviors toward such sectors. This strand of reasoning does not presume enhanced analytical ability or improved ESG awareness per se, but rather a psychological or ethical distancing from previously encountered high-emission environments.

According to March and Olsen (1989) and Higgins (2005), individuals internalize the norms, values, and emotional reactions associated with their prior organizational contexts. These imprints shape subsequent behaviors even in entirely new institutional settings. For example, professionals who have worked in controversial industries (such as mining or fossil fuel production) may develop long-term aversions toward similar sectors due to internalized discomfort or reputational awareness. This view is reinforced by research in moral psychology and occupational ethics. Ashforth et al. (2017) highlight how exposure to morally contested or “dirty” industries can create enduring moral distancing tendencies. Similarly, Feinberg et al. (2012) demonstrate that repeated exposure to ethically problematic work environments influences individuals’ prosocial attitudes and moral reasoning, often leading to increased ethical sensitivity and rejection of comparable contexts in future roles.

In fund management, such experiences may cause managers to intuitively associate carbon-intensive firms with reputational or moral risk, prompting them to avoid these firms not because of economic or regulatory concerns, but due to affective or ethical discomfort. Lewis et al. (2014) find that executives with environmental or engineering backgrounds, especially those from high-pollution industries, are more likely to distance themselves from polluting firms in their future investment or strategic roles. Therefore, we propose second hypothesis.

H2: Fund managers with prior experience in carbon-intensive industries are more likely to avoid high-emission firms in their investment portfolios, reflecting a behavioral and ethical aversion shaped by their previous industry exposure.

3 Research Design

3.1 Sample and data

To construct our sample, we identify diversified U.S. domestic equity mutual funds managed by a single manager. We impose three sequential restrictions on the universe of mutual funds in the Morningstar Mutual Fund Database. First, we restrict the universe to mutual funds with headquarters and primary trading markets in the United States. Second, we remove funds that cannot be linked to fund holdings in the Thomson Reuters Mutual Fund Database. Finally, we further restrict the sample to include only funds managed by a single portfolio manager. The rationale for this restriction is that our subsequent tests would be less precise for funds managed by multiple managers, particularly when some managers have relevant industry experience while others do not.

To identify fund manager names and the time periods during which they managed individual funds, we rely on the Manager History database from Morningstar. We choose Morningstar over the CRSP Mutual Fund database because prior research documents that manager information reported by Morningstar is more accurate (Patel and Sarkissian, 2013). This process yields a final sample of 1,260 fund managers between 2008 and 2023.

Morningstar provides reliable information on manager identities and management tenures but does not contain detailed information on managers' pre-fund-management career histories. To construct managers' career profiles, we therefore manually collect biographical information from multiple publicly available sources, including fund family websites, Morningstar.com manager profiles, SEC filings (e.g., prospectuses and Statements of Additional Information), newspaper articles, and professional networking websites such as ZoomInfo and LinkedIn. Using these sources, we reconstruct each manager's employment history prior to entering the mutual fund management industry by recording the names of employers, the periods of employment, and job descriptions. Biographical information is successfully collected for 1,203 of the 1,260 managers in our sample.

We use the reconstructed employment histories to identify managers' prior industry experience. Each pre-management employer is mapped to the Fama–French 48 industry classification. A fund manager is classified as having work experience in a given industry if at least one employer he or she worked for before entering fund management belongs to that industry. When information from different sources conflicts, we prioritize SEC filings and official fund family disclosures over third-party profiles. This procedure allows us to construct our key independent variable measuring managers' pre–fund-management industry experience.

3.2 Regression Model and variables

To examine the relationship between fund managers', work experience in carbon intensive industry and portfolio carbon emissions, the baseline OLS regression model is as follows. We firstly run Ordinary Least Squares (OLS) regression for the baseline model (1) below. The standard errors are clustered at the fund level to perform heteroscedasticity and within-fund correlation correction in the residuals (Petersen, 2008). We also employ lagged control variables to replace the original control variables to mitigate the endogeneity concerns in regression, as it may need some time for experience fund managers to have influence on decisions of investment.

$$\begin{aligned} \text{carbon intensity}_{j,t} = & \alpha + \beta_1 * \text{work experience}_{j,t-1} + \beta_2 * \text{controls}_{j,t-1} \\ & + \gamma_1 * \text{year effects}_t + \gamma_2 * \text{fund effects}_j + \gamma_3 * \text{manager effects}_j + \varepsilon_{j,t} \end{aligned} \quad (1)$$

In model (1), The independent variable *work experience*_{*j,t-1*} is a dummy variable indicating whether a fund *j* is managed by at least one manager with prior work experience in a carbon-intensive industry, such as natural resources or energy. Following Ardia et al. (2023), we classify high–carbon industries based on the Fama–French 48-industry classification, identifying sectors with significantly elevated greenhouse gas (GHG) intensity. This taxonomy ensures a consistent and empirically validated industry classification, and its application in environmental performance research is further supported by Bendig et al. (2025), who demonstrate its superior carbon homogeneity compared to alternative classification systems (SIC, NAICS, GICS). This variable captures the unique environmental awareness and potential carbon-management insights that managers with such backgrounds may bring to their investment decisions. To construct a fund-level indicator of environmental exposure, we

calculate dependent variable *Carbon sensitivity*¹ for each fund-year, separately for Scope 1, Scope 2, and Scope 3² emissions. *Carbon sensitivity*³ is calculated for fund *j* in year, this measure reflects the intensity of carbon emissions embedded in a fund's holdings, normalized by fund size. Specifically, for each company held by a fund, we compute the holding ratio as the number of shares the fund holds in that company divided by the fund's total shares held across all portfolio firms. This ratio is then used to weight the company's carbon emissions, producing a fund-level exposure to carbon emissions based on proportional ownership. The weighted carbon emissions are aggregated across all holdings to obtain a total carbon footprint for the fund. Finally, to standardize across funds of different sizes, this total is divided by the fund's net assets, yielding a carbon intensity measure per thousand units of fund assets.

We also include multiple control variables at fund level; we control factors that might impact carbon sensitivity indirectly. *Expense ratio* serves as an indicator of fund costs that can affect net returns and potentially influence a fund's strategy, including sustainability initiatives (Carhart, 1997). *Turnover ratio*, reflecting portfolio rebalancing frequency, captures trading behavior, as more frequent trades could be linked to higher emissions due to investments in sectors with carbon-intensive operations (Grinblatt and Titman, 2001). *Return* represents overall fund performance and could be associated with higher sensitivity to carbon emissions in environmentally conscious funds, following literature that connects financial performance with sustainable strategies (Odean et al., 1998). *Fund age* accounts for fund maturity and stability, as older funds may demonstrate more established ESG policies (Pástor, Stambaugh and Taylor, 2021). We also control *fund size*, measured as the square root of total asset value, controls for scale effects, allowing us to distinguish large funds, which might have a different approach to emissions management due to enhanced resources and visibility (Chen, Hong and Stein, 2002). Finally, we include *Sustainability Rating* and *Morningstar Rating* as control variables to account for non-managerial fund characteristics that may influence carbon outcomes according to previous literature. The *Sustainability Rating*, developed by Morningstar based on company-

¹ The dependent variable is calculated as three different scopes of carbon emissions divide by fund size. The three scope carbon emissions data is from Truecost database, which include detailed carbon emissions category.

² Carbon emissions are typically categorized into three scopes, as defined by the Greenhouse Gas Protocol. Scope 1 emissions are direct greenhouse gas emissions from sources owned or controlled by the company, such as fuel combustion and industrial processes. Scope 2 emissions are indirect emissions from the generation of purchased electricity, steam, heating, and cooling consumed by the reporting company. Scope 3 emissions encompass all other indirect emissions that occur in a company's value chain, including upstream and downstream activities such as purchased goods and services, business travel, and use of sold products. Scope 2 does not include Scope 1, and Scope 3 is a distinct category that does not subsume Scope 1 or Scope 2 emissions.

³ This approach follows the asset-weighted carbon foot printing methodology widely used in sustainable finance literature (see Busch, Bauer, & Orlitzky, 2016; Ilhan, Sautner, & Vilkov, 2021) and aligns with institutional carbon disclosure standards such as those from the Task Force on Climate-Related Financial Disclosures (TCFD).

level ESG data provided by Sustainalytics, reflects how well the companies in a fund's portfolio manage material environmental, social, and governance risks. A higher sustainability rating indicates that the fund is composed of firms with lower ESG-related risk exposure and is commonly used in research evaluating ESG alignment at the portfolio level (Hartzmark and Sussman, 2019). Meanwhile, the *Morningstar Rating*, commonly referred to as the "Star Rating", is a risk-adjusted return measure that evaluates a fund's past performance relative to its peers. This rating captures both return and volatility over a given period, helping to control for the quality and consistency of fund management. Numerous empirical studies incorporate Morningstar Ratings to account for historical fund performance when analysing manager behaviour or fund flows (Barber and Odean, 2001). These variables, computed at the fund level to align with our fund-specific analysis, allow us to isolate the effect of a fund manager's industry experience on the portfolio's carbon sensitivity.

By including these controls, we aim to provide a better understanding of how fund-level factors interact with fund managers' backgrounds to influence carbon-related investment behavior. Definition of variables can be found in Appendix 1.

3.3 Descriptive statistics

Table 2 presents the summary statistics for the primary variables in fund and firm level in the analysis, illustrating distinct characteristics across multiple dimensions, including the independent and dependent variables, as well as fund-level and firm-level control variables. Panel A highlights the primary dependent variable *Fund Carbon Sensitivity* which is weighted carbon emissions in three scopes relative to fund assets (dependent variable) and independent variable *Work Experience* (dummy variable). Carbon emissions are categorized into Scope 1, Scope 2, and Scope 3 emissions, representing direct and indirect emissions. Specifically, *Fund Carbon Sensitivity (Scope 1)* emissions per total assets have a mean of 0.0317, *Fund Carbon Sensitivity (Scope 2)* average at 0.0097, and *Fund Carbon Sensitivity (Scope 3)* emissions stand at 0.0609, indicating a higher emphasis on indirect emissions. *Work Experience*, representing fund managers' background in relevant industries, has a mean of 0.0141, suggesting that not many managers have carbon-intensive industry experience.

[Insert Table 1 about here]

The fund-level control variables offer insight into the characteristics and behaviors of funds in the sample. For example, Fund Age averages around 12 years, ranging from 7 to 36, suggesting that most funds in the sample are relatively mature, which may contribute to investment stability or reputation-based advantages. On average, funds charge an expense ratio of 1.09% and exhibit a turnover rate of 50.15%, suggesting the presence of highly active trading strategies among some funds.

The average annual return is 9.12%, with a substantial standard deviation, reflecting heterogeneity in fund performance. Fund size also varies significantly, with a mean of 19.6 (log scale or billion units), potentially influencing fund behavior via liquidity constraints or market impact. Both Morningstar Ratings and Sustainability Ratings center around a mean of approximately 2.9, indicating moderate overall quality and ESG performance among the sample funds. Overall, the summary statistics reflect considerable diversity in fund characteristics, supporting the relevance of fund manager background as a source of heterogeneity in investment behavior.

4 Main Results

We first examine whether fund managers with carbon intensive industry experience have an impact on their portfolio's carbon emissions by regressing model (1). Table 2 presents the regression results, with the dependent variable defined as the *Fund Carbon sensitivity* of three scopes, measured by aggregated firm's Scope 1, Scope 2, and Scope 3 emissions in fund portfolio relative to fund size. The key independent variable of interest is *Work Experience*, a dummy variable indicating whether a fund manager previously worked in a carbon-intensive sector (e.g., natural resources, utilities, manufacturing, or automotive).

[Insert Table 2 about here]

Columns (1) through (3) include fund and year fixed effects, and the coefficients on the *work experience* variable are consistently negative and statistically significant across all three scopes. Specifically, Scope 1 carbon sensitivity is reduced by approximately 0.0509 for Scope 1, 0.0169 for Scope 2, and 0.0527 for Scope 3, respectively. This implies that for every 1 million USD in fund assets, managers with carbon-intensive industry experience are associated

with an average reduction of approximately 14.78¹ units of Scope 1 emissions. Similarly, the reductions are around 4.709 and 14.68 for Scope 2 and Scope 3 emissions, respectively. These reductions are substantial, especially considering they are realized across the entire portfolio and persist even after controlling for fund-level factors such as size, expense ratio, turnover, past return, and ESG-related ratings.

Columns (4) to (6) further strengthen these findings by incorporating manager fixed effects, which control for time-invariant unobservable characteristics at the individual manager level. Once these are accounted for, the magnitude of the coefficients becomes even more pronounced: -0.0771 for Scope 1, -0.0311 for Scope 2, and -0.0766 for Scope 3, all highly significant at the 1% level. This further validates the notion that the observed carbon reductions are not simply driven by observable fund characteristics or spurious correlations but rather reflect systematic differences in managerial decision-making behaviour linked to past industry exposure.

These results provide strong empirical support for Hypothesis 2, which suggest that fund managers with prior carbon-intensive industry experience are more likely to construct portfolios with lower carbon emissions. Rather than show their preference for familiar industries, these managers avoid those high-emission firms, which suggests that their prior exposure to carbon-intensive operations may have a lasting sense of disapproval toward such business models. Consistent with theories of career imprinting and work socialization (Higgins, 2005; Van Maanen & Schein, 1979), the norms and values internalized in earlier work environments can shape future decision-making ways. Managers previously employed in high-emission sectors may come to associate such firms with reputational, ethical, or operational concerns, leading to an intuitive distancing from similar enterprises in their current investment strategies. This behavioral tendency reflects a negative moral imprinting, avoiding the high carbon intensive industries firms under the current green-target world.

5 Mechanisms Linking Manager Experience to Carbon Emissions Reduction

In this section, we evaluate the mechanisms through which managers with high carbon intensive industry experience can influence changes in the carbon emissions in their portfolios.

¹ For scope 1 carbon emissions, we calculate the economic magnitude following Wooldridge's work based on several steps. First, we convert average fund size (log of fund net asset) to average fund asset: $e^{5.63} = 278.66$ million USD. Second, we calculate each fund with such experience manager will have lower carbon emissions around 14.18 tons ($0.0509 \text{ tons} * 278.66$) compare to other managers without such experience.

One potential mechanism could be selection, as fund managers may select firms with low carbon emissions to create portfolio. The literature shows that institutional investors can influence firms' carbon emissions—and, more broadly, their ESG performance—through mechanisms such as exit and selective investment (e.g., Cox and Wicks, 2011). Carbon-intensive experience managers may employ negative screening to exclude firms with high carbon emission or use positive screening to choose firms included in portfolio and make fund with lower carbon emissions compare with others without such experience.

Apart from the selection motive, carbon intensive experience managers may also monitor their portfolio's firm to keep low level of carbon emissions. Literature suggests that institutional investors can “behave both as watchdogs and enforcers of good corporate governance, using ‘voice’ to influence corporate behaviour” (Klettner, 2021). Institutional investors often engage actively with portfolio companies to address climate risks, preferring engagement over divestment as a strategy to influence sustainability practices (Krueger *et al.*, 2020). Stewardship codes have formalized this monitoring role, emphasizing investors' responsibility to guide corporate behaviour and promote long-term value creation through oversight and active engagement (Klettner, 2021), and investors' preferences for ESG-aligned investments contribute to their monitoring activities, pressuring firms to adopt more sustainable practices (Riedl and Smeets, 2017). Collectively, these findings underscore the importance of monitoring as a mechanism through which institutional investors, including fund managers, can actively shape corporate strategies and responses to climate-related challenges, thereby reducing carbon emissions and enhancing ESG outcomes.

We first test whether the effect operates through a selection channel. This analysis focuses on fund managers' initial investment choices, independent of any post-investment influence or firm engagement activities. We only include data for the first year when a fund manager holds a firm and ignore all the subsequent years in our analysis. We then re-run the baseline model (1). If the selection effect holds, we would expect the existence of a negative relationship between carbon intensive experience managers and their portfolio firms' carbon emissions for the first-year data. Results are reported Table 3.

[Insert Table 3 about here]

Across all three scopes, we find that the coefficients for fund managers with carbon-intensive backgrounds are consistently negative and statistically significant at the 1% level.

These results suggest that such managers reduce their portfolio carbon emissions through the selection mechanism. This finding is consistent with previous literature showing that managers with environmentally sensitive are more likely to stay away from firms with negative environmental emissions (Higgins, 2005; Lewis et al., 2014).

Therefore, the evidence presented in Table 3 provides strong support for a selection mechanism, fund managers with carbon-intensive experience reduce emissions through proactively avoid high-emission firms at the selection stage.

We then examine whether fund managers with high carbon intensive industry experience engage in monitoring roles to influence their portfolio's carbon emissions. We regress the impact of carbon intensive experience managers on mutual funds' support rates for shareholder proposals related to (1) climate change, (2) broader environmental issues, and (3) other environmental and social (E&S) topics, respectively. A higher support ratio signals a greater willingness to exert influence over firm behaviour, thus reflecting the manager's commitment to ESG monitoring beyond initial portfolio construction (Dimson et al., 2015; Grewal et al., 2016). Therefore, if carbon intensive experience managers actively monitoring their fund and portfolio firms, they would be more likely to support ESG-related proposals that promote sustainability and corporate responsibility.

[Insert Table 4 about here]

Table 4 presents regression results that fund managers with high carbon industry experience is associated with increased level of support for ESG proposals. Specifically, funds with high carbon intensive industry experience managers are more likely to support *climate change-related proposals* (Column 1), broader *environmental proposals* (Column 2), and *other E&S-related* shareholder actions (Column 3). These results suggest that past experience in carbon-intensive sectors may motivate fund managers to exert monitoring pressure on firms regarding sustainability practices.

Except the regression method to test the monitoring effects of fund managers. We further examine Figures 1 to 3, which illustrate the evolution of portfolio firms' carbon emissions over a ten-year time window following the initial investment by such managers. Each figure corresponds respectively to Scope 1, Scope 2, and Scope 3 emissions, with the x-axis denoting the time window in years, defined as the end year of the holding period minus the start year,

and year 0 indicating the first year a company is held by an experienced manager. The y-axis captures the average emissions level across all firms held by these managers within carbon emissions scope 1 to scope 3.

[Insert Figure 1, 2, and 3 about here]

In three figures, a common trend is obvious: portfolio's carbon emissions demonstrate a persistent and gradual decline following the initial investment year. This decreasing trend continues up to 10-year time window, suggesting that the portfolios held by fund managers with carbon-intensive backgrounds tend to have lower carbon emissions over time. This pattern is not only consistent across direct emissions (Scope 1) but also holds for indirect emissions from energy consumption (Scope 2) and broader supply-chain and downstream activities (Scope 3), indicating a robust effect. The decline over an extended holding period provides strong visual evidence that such managers do not only select low-emission firms to their fund portfolio at the beginning, but rather actively engage in monitoring and influence over the environmental practices of portfolio firms.

6 Fund managers experience linked with specific firm carbon emissions

At the fund level, we conclude that managers with experience in carbon-intensive industries help lower portfolio emissions through selection and monitoring effect. While aggregate patterns at the fund level provide strong initial evidence, the result does not reveal how management influence manifests itself specifically within individual firms. We now focus on the firm level. To address this gap, we explore whether firms reduce carbon emissions when exposed to managers with such experience because lower carbon emissions attract more managers to invest. This approach allows us to assess whether the previously observed fund-level effects hold at firm-level results.

In order to reveal how management influence manifests itself specifically within individual firms, we use model (2) to test the relationship between independent variable *Firm_ExpManager_Ratio*, which is measured by the ratio of fund managers investing in the firm who have prior work experience in carbon-intensive industries and dependent variable firms' carbon sensitivity, *log (carbon emissions/revenue)* in three scopes of firm.

$$\begin{aligned} \text{Log}(\text{carbon emissions/revenue})_{i,t} = & \alpha + \beta_1 * \text{Firm ExpManager Ratio}_{i,t-1} + \beta_2 * \text{controls}_{i,t-1} \\ & + \gamma_1 * \text{year effects}_t + \gamma_2 * \text{firm effects}_i + \varepsilon_{i,t} \end{aligned} \quad (2)$$

The dependent variables are the logarithm of Scope 1, Scope 2, and Scope 3 emissions scaled by firm's revenue, reflecting different layers of carbon responsibility: Scope 1 captures direct emissions from owned or controlled sources; Scope 2 reflects indirect emissions from the generation of purchased energy; and Scope 3 includes all other indirect emissions that occur in the value chain of the firm (e.g., supply chain or product use). The key independent variable is the percentage of fund managers holding a position in a firm who have prior work experience in high-carbon sectors and we include the firm level controls, including, *Tobin's Q*, a proxy for growth opportunities, which is measured by the market value of equity plus total assets minus the book value of equity and all of them divided by total assets; *Cash/Net assets*, a proxy for cash reserves, which is captured by cash and cash equivalents divided by net assets (i.e. total assets minus cash and cash equivalents); *Leverage*, measured by the ratio of total debt which is long-term debt plus short-term debt to total assets; and *firm size*, which is measured by the logarithm of total assets (Chen *et al.*, 2017 and Liu *et al.*, 2014). Definition of variables can be found in Appendix 1.

[Insert Table 5 about here]

The regression results show a consistently negative and statistically significant relationship between the carbon intensive experienced fund managers and firms' carbon emissions across all three scopes. These findings suggest that firms with higher ownership by such managers tend to exhibit lower carbon intensities and such fund managers may also influence firms' broader value chain emissions. The negative relationship of scope 1 is obvious and straight, fund managers with high carbon industry experience have left them with the moral distancing from ethically problematic environments (Ashforth *et al.*, 2017) and supports the theory that workplace socialization can shape long-term behavioral responses (Feldman, 1981; Higgins, 2005).

For scope 2 emissions, material component of a firm's environmental footprint, which result from the purchase of electricity, heat, or steam, are indirect but highly linked to the firm's operational energy profile, particularly in energy-intensive industries (CDSB, 2021; Downar *et al.*, 2021). These emissions often reflect the carbon intensity of a firm's production infrastructure and its energy sourcing decisions, managers with high carbon industrial backgrounds may have dealt with closely in their previous roles. Such managers may associate high Scope 2 emissions with structural inefficiencies, outdated technologies, or regulatory non-compliance risks norms that were noticeable in their prior sectors. Therefore, these managers

may develop moral aversion toward firms heavily reliant on carbon-intensive electricity or thermal inputs.

While the observed avoidance of firms with high Scope 1 and Scope 2 emissions by fund managers with carbon-intensive industry backgrounds can be reasonably interpreted through operational familiarity and institutional aversion, their consistent sensitivity to Scope 3 emissions presents a more nuanced pattern. Scope 3 emissions encompass indirect emissions along the value chain, including upstream supplier activities, downstream product use and disposal, investments, franchises, and leased assets. These emissions are generally more difficult to measure, less standardized across firms, and harder for external investors to directly observe or influence.

[Insert Table 6 about here]

To better understand this finding, we disaggregate Scope 3 emissions into its major subcomponents. As reported in Table 6, only upstream Scope 3 emissions, those generated by suppliers, exhibit a statistically significant negative association with managers' prior experience in carbon-intensive industries. In contrast, downstream emissions, investment-related emissions, franchise emissions, and emissions from leased assets show no significant relation. This heterogeneity suggests that managers' sensitivity to Scope 3 emissions is not broad-based but instead concentrated in areas where their past industry experience is most informative.

A key distinction between upstream emissions and other Scope 3 categories lies in risk transmission and managerial learnability. In carbon-intensive sectors such as mining, heavy manufacturing, energy, and chemicals, upstream supplier activities are closely tied to production continuity, regulatory compliance, and reputational exposure. Through direct involvement in these industries, managers are likely to have internalized the operational and regulatory risks embedded in carbon-heavy supply chains. Supplier-related environmental violations can trigger regulatory scrutiny, production disruptions, or reputational spillovers that are quickly transmitted to downstream firms. As a result, upstream emissions represent a form of predictable and economically salient risk rather than a purely ethical or environmental concern.

In contrast, other Scope 3 components are either more demand-driven (e.g., downstream emissions related to consumer usage), more structurally indirect (e.g., investment-related emissions), or governed by contractual and organizational arrangements that dilute accountability (e.g., franchises and leased assets). These emission categories are less directly connected to firms' core operations and are therefore harder for managers to assess, monitor, or translate into valuation-relevant risk. Consequently, managers' prior experience does not systematically map into stronger aversion toward these categories.

This interpretation aligns with the literature emphasizing the economic and reputational implications of carbon-intensive supply chains. Zhao et al. (2022) show that upstream carbon exposure increases firms' vulnerability to regulatory interventions, while Plambeck and Taylor (2014) document that environmental violations by suppliers lead to an average stock price decline of 1.8% for buyer firms and substantially increase the likelihood of ESG rating downgrades. These findings suggest that upstream emissions constitute a salient channel through which environmental risks propagate across firms.

The evidence in Table 6 indicates that managers with carbon-intensive industry backgrounds do not simply exhibit a generalized preference for low-emission firms. Instead, their investment decisions reflect experience-based screening, whereby they selectively avoid firms embedded in carbon-intensive supply chains, which is the segment of Scope 3 emissions where their prior industry exposure provides the greatest informational advantage and risk awareness.

7 Identification strategy and endogeneity considerations

The analysis of fund managers' prior carbon-intensive industry experience may raise concerns about endogeneity, a common issue in studies examining the impact of managerial background on decision-making outcomes (e.g., Bertrand & Schoar, 2003; Custódio & Metzger, 2014). Specifically, managers with carbon-intensive experience may self-select into funds or portfolios that align with their moral disposition leading to lower portfolio carbon emissions. In this case, the estimated association between managerial background and emissions may reflect unobserved behavioral or ethical traits, not causal effects of prior work experience. Therefore, three approaches to address potential concerns of endogeneity: (1) entropy balancing to ensure covariate balance between treatment and control groups, (2) a difference-

in-differences (DID) approach leveraging managerial turnover events, and (3) an instrumental variable (IV) strategy using state-level industrial indicators.

7.1 Entropy Balance

We first implement entropy balancing (Hainmueller, 2012; Hainmueller & Xu, 2013), a data preprocessing method that improves covariate balance in observational studies by reweighting the sample. Unlike conventional propensity score matching (Rosenbaum and Rubin, 1983), entropy balancing directly adjusts the weights of the control group observations so that the weighted moments (mean, variance, skewness) of the covariates match those of the treated group. This allows us to retain the full sample while achieving near-perfect balance across observable characteristics such as fund size, past return, ESG scores, firm size, industry, and year. As shown by Imai and Ratkovic (2014), entropy balancing outperforms traditional matching and weighting methods in terms of both bias reduction and estimation efficiency, particularly in high-dimensional settings.

This approach is suitable in studies on fund manager traits, where selection into treatment (i.e., the assignment of a manager with high-carbon industry background) is likely non-random and influenced by fund mandates or regional industrial structures. By balancing the observable characteristics that could simultaneously influence both the likelihood of hiring such a manager and the portfolio's carbon outcome, entropy balancing improves the internal validity of our results and strengthens causal inference (Blackwell et al., 2009). Following these literature, our analysis ensures rigorous covariate comparability between treatment and control groups before estimating the effect of fund manager experience on portfolio and firm emissions.

[Insert Table 7 about here]

Panel A of Table 7 presents the results of the covariate balancing process. The treated group consists of firm-year observations in which a company is held by at least one fund manager with prior experience in carbon-intensive industries, while the control group comprises firm-years held exclusively by managers without such experience. Before entropy balancing, treated firms differ from control firms in several dimensions, including lower leverage and lower ROE, potentially biasing the relationship between manager experience and firm emissions. After applying entropy weights, these imbalances are fully eliminated, with

standardized biases in all observed characteristics reduced to zero, confirming the successful balancing of observable covariates.

Panel B reports the regression results using the entropy-weighted sample. The dependent variables are the log of Scope 1, Scope 2, and Scope 3 carbon emissions, each normalized by revenue to reflect emissions intensity. The key explanatory variable is *Firm_ExpManager_Ratio*, defined as the proportion of fund managers investing in the firm who have previous work experience in carbon-intensive industries. Across all three models, we find a statistically significant and economically meaningful negative relationship between the carbon intensive experience managers and firm-level carbon emissions intensity in three scopes. This suggests that a higher presence of such managers is associated with lower carbon emissions and better environmental performance, which further support our second hypothesis.

7.2 DID

We further use a difference-in-differences (DID) identification strategy that exploits managerial turnover as an exogenous shock. This approach builds on a growing literature using managerial transitions as a quasi-natural experiment to identify the impact of managerial traits on firm behavior. Bertrand and Schoar (2003) pioneer this method by showing how manager fixed effects explain persistent differences in corporate policies. Similarly, Custódio and Metzger (2014) show that CEOs with generalist experience are more likely to be hired during uncertain times, using changes in CEO characteristics as a source of variation.

We define the treatment as cases where a fund manager with prior work experience in carbon-intensive industries replaces a manager without such experience. This turnover is unrelated to firm-level carbon performance, especially when the manager transition results from fund-level internal dynamics rather than firm-level characteristics. Specifically, showing in model (3), our estimation strategy interacts a turnover shock indicator with a post-transition dummy, and controls for firm and year fixed effects.

$$\text{Firm carbon sensitivity}_{i,t} = \alpha + \beta_1 * (\text{Manager replacement} * \text{Post})_{i,t} + \beta_2 * \text{controls}_{i,t} + \gamma_1 * \text{year effects}_t + \gamma_2 * \text{firm effects}_i + \varepsilon_{i,j,t} \quad (3)$$

where *Manager replacement* is a dummy variable that equal to 1 if a manager with carbon-intensive industry experience replaces one without such experience and the post period

equals one after an experienced manager replaces a manager without experience, and zero otherwise. As shown in Table 8, Panel A confirms that, after propensity score matching (PSM), key firm characteristics such as ROE, Tobin's Q, leverage, and firm size are well balanced between the treatment and control groups in the pre-treatment period, suggesting suitable comparability.

[Insert Table 8 here]

Panel B presents the DID estimation results. The interaction term *Manager replacement* $\times$ *Post* is negative and statistically significant across all three scopes of carbon emissions (Scope 1, Scope 2, and Scope 3), indicating that firms have a significant decline in carbon emissions following the entry of fund managers with carbon-intensive industry experience. These results remain robust after including a comprehensive set of controls and firm and year fixed effects. The estimated reductions are economically meaningful, with Scope 1 emissions declining by 21.7%, Scope 2 by 15.4%, and Scope 3 by 19.1% on average. By capturing the change in emissions before and after managerial transition within the same firm and comparing it to a control group, we confirm that after the appointment of carbon intensive experience managers, firm with low carbon emissions are more attractive for managers with high-carbon experience.

7.3 Instrument Variable

We further address potential endogeneity concerns regarding the allocation of fund managers with carbon-intensive industry experience by a two-stage least squares (2SLS) regression as shown in Table 9. The main independent variable, *Firm_ExpManager_Ratio*, may be endogenous due to omitted variable bias. To mitigate this concern, we instrument *Firm_ExpManager_Ratio* using *Energy Consumption per capita* at the U.S. state level, which serves as a proxy for the likelihood that a region historically hosted carbon-intensive industries and thus produced more fund managers with relevant experience.

[Insert Table 9 about here]

In the first stage of the 2SLS approach, we instrument *Firm_ExpManager_Ratio* using the average *Energy Consumption per capita* at the U.S. state level. This instrument captures the idea that fund managers' prior career experience is shaped by the industrial landscape of the

regions in which they began their careers. States with historically higher per capita energy consumption tend to be more industrialized and are more likely to host carbon-intensive industries such as oil and gas, mining, or manufacturing. As a result, these states are more likely to produce fund managers with work experience in such carbon-intensive sectors.

This regional link between industrial exposure and manager experience ensures that *Energy Consumption per capita* is a meaningful source of exogenous variation. By exploiting this exogenous supply-side factor, the first stage establishes more carbon-intensive regional environments increase the proportion of fund managers with related industry experience in the investment pool.

The second-stage results (Columns 2 to 4) show that the instrumented *Firm_ExpManager_Ratio* remains negatively and significantly associated with firm-level carbon emissions across all scopes. These results are consistent with the baseline findings and reinforce the argument that fund managers with carbon-intensive industry backgrounds play an active role in reducing portfolio firms' emissions.

8 Conclusion

This study explores whether and how mutual fund managers' prior work experience in carbon-intensive industries influences the environmental performance of their investment portfolios. Depending on theories of work socialization and career imprinting, we find that such experience may leave long-lasting cognitive and moral imprints, shaping investment behavior in meaningful ways. While prior research has largely focused on performance, asset allocation, or familiarity-driven sector bias, this study broadens the scope by investigating the implications of managerial background for the carbon emissions of invested firms.

Our empirical results show that, at the fund level, managers with carbon-intensive industry experience construct portfolios with significantly lower carbon emissions. This finding suggests that their prior exposure does not directly toward polluting sectors, but instead motivates more environmentally cautious investment decisions. We further examine the mechanism behind this observed reduction and find evidence supporting both selection and post-investment monitoring effects. Specifically, managers with carbon-intensive experience not only avoid highly polluting firms at the outset but also actively monitor and influence the emissions performance of their existing portfolio companies.

To further test this influence, we extend our analysis to the firm level. Results indicate that the negative relationship between managerial background and firm emissions persists across Scope 1, 2, and 3 emissions, confirming that the impact is not limited to fund composition but extends to the actual environmental behavior of invested firms. A more granular examination of Scope 3 emissions reveals that the reduction effect is concentrated in upstream supply-chain emissions. This suggests that fund managers may exert influence on firms' decisions and supplier engagement practices, areas often neglected in traditional ESG frameworks.

This paper contributes to the literature by identifying a previously overlooked channel through which individual managerial characteristics, specifically prior employment in high-emission industries, shape sustainable investment outcomes. The findings highlight the importance of examining not only institutional mandates or firm-level ESG strategies, but also the biographies and moral frameworks of individual decision-makers. As climate-related investing becomes more central to asset management practice, understanding the human experience drivers behind low-carbon transitions will be increasingly critical.

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Table 1: Statistics summary of variables.

Panel A fund level					
Variable	Observations	Mean	Standard deviation	Min	Max
Fund Carbon Sensitivity (Scope 1)	28,647	0.0317	0.1621	0.0000	2.3996
Fund Carbon Sensitivity (Scope 2)	28,647	0.0097	0.0725	0.0000	1.0517
Fund Carbon Sensitivity (Scope 3)	28,647	0.0609	0.5303	0.0000	12.1011
Work experience	28,647	0.0141	0.1182	0.0000	1.0000
Fund age (years)	28,647	12.0995	5.7165	7	36
Expense (%)	28,647	1.0915	0.5314	0.2	2.91
Turnover (%)	28,647	50.1481	77.7861	0.26	663
Return (yearly)	28,647	9.1216	19.3764	-30.87	52.08
Fund size	28,647	5.6301	3.2918	-9.9034	10.6736
Morningstar rating	28,647	2.9407	0.6669	1	5
Sustainable rating	28,647	2.8726	1.15273	1	5
Panel B firm level information					
Variable	Observations	Mean	Standard deviation	Min	Max
Firm_ExpManager_Ratio	40,146	0.0055	0.0533	0	1
Log(scope1/revenue)	40,146	2.6242	1.8792	-6.8944	9.0042
Log(scope1/revenue)	40,146	2.9001	1.1252	-6.4187	8.4701
Log(scope1/revenue)	40,146	4.6130	0.9379	-0.5578	7.8042
ROE	40,146	2.0632	61.5351	-2803.309	1361.303
Tobin's Q	40,146	1.9061	2.2396	0.0017	45.2190
Cash/Net Asset	40,146	0.1173	0.1191	0	0.9653
Firm size	40,146	8.2985	1.4883	2.5011	14.6979
Leverage	40,146	-0.0214	35.953	-1481.887	882.7288

Table 1 presents descriptive statistics information for the independent variable carbon-intensive industries work experience and dependent variables of carbon sensitivity and other control variables.

Table 2: Fund level regression of work experience fund manager and investee firms' carbon emissions.

	(1) Fund Carbon sensitivity (Scope 1)	(2) Fund Carbon sensitivity (Scope 2)	(3) Fund Carbon sensitivity (Scope 3)	(4) Fund Carbon sensitivity (Scope 1)	(5) Fund Carbon sensitivity (Scope 2)	(6) Fund Carbon sensitivity (Scope 3)
Work experience _{t-1}	-0.0509*** (-2.9294)	-0.0169** (-2.1636)	-0.0527*** (-2.8682)	-0.0771*** (-10.0303)	-0.0311*** (-7.0536)	-0.0766*** (-9.1666)
Fund size _{t-1}	-0.1093*** (-3.5255)	-0.0352** (-2.5248)	-0.0784** (-2.6057)	-0.1126*** (-12.1559)	-0.0378*** (-7.6134)	-0.083*** (-8.5389)
Expense(%) _{t-1}	0.1194* (1.8833)	0.0487 (1.4784)	0.1362* (1.8391)	0.1259*** (8.1243)	0.0514*** (6.7837)	0.1417*** (8.724)
Turnover(%) _{t-1}	0.0002 (1.5541)	0.000 (-0.1964)	0.0001 (0.737)	0.0002*** (7.413)	0.000 (-0.9633)	0.0001*** (4.8068)
Return _{t-1}	0.0003 (0.3072)	0.0005 (1.0351)	0.0005 (0.5593)	0.0003** (2.1073)	0.0005*** (5.3489)	0.0005*** (3.2122)
Sustainable Rating _{t-1}	0.0293* (1.7284)	0.0136 (1.5216)	0.0156 (0.9108)	0.0304*** (7.929)	0.0142*** (6.9226)	0.0167*** (4.2304)
Morningstar Rating _{t-1}	0.0322 (1.7019)	0.013 (1.6104)	0.0307* (1.8338)	0.0359*** (8.3274)	0.014*** (6.7216)	0.0332*** (7.9604)
_cons	1.847*** (4.0646)	0.5618*** (2.8403)	1.2728*** (2.8531)	1.8888*** (12.6338)	0.6059*** (7.5708)	1.3467*** (8.6443)
Observations	28636	28636	28636	28634	28634	28634
R-squared	0.5284	0.3773	0.5177	0.5335	0.3801	0.5203
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Manager FE				Yes	Yes	Yes

This table presents the regression results of model (1), where work experience is a dummy variable measured by fund manager who have carbon intensive work experience in single managed mutual fund. It is equal to 1 if single managed fund manager has carbon intensive work experience and equal to 0 otherwise. Carbon sensitivity of three scopes is calculated for fund j in year, this measure reflects the intensity of carbon emissions embedded in a fund's holdings, normalized by fund size. Specifically, for each company held by a fund, we compute the holding ratio as the number of shares the fund holds in that company divided by the fund's total shares held across all portfolio firms. This ratio is then used to weight the company's carbon emissions, producing a fund-level exposure to carbon emissions based on proportional ownership. The weighted carbon emissions are aggregated across all holdings to obtain a total carbon footprint for the fund. Finally, to standardize across funds of different sizes, this total is divided by the fund's net assets, yielding a carbon intensity measure per thousand unit of fund assets. Columns 1 to 3 show the results of regressions with carbon emissions of scope 1 to 3 and all control variables are included. Year fixed effects, fund fixed effects and Manager individual fixed effects are included. T-values are shown in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively. All variables are defined in Appendix 1.

Table 3: Selection Effect of Fund Managers with Carbon-Intensive Industry Backgrounds on carbon emissions in investment portfolio

	(1) Fund Carbon sensitivity (Scope 1)	(2) Fund Carbon sensitivity (Scope 2)	(3) Fund Carbon sensitivity (Scope 3)
Work experience _{t-1}	-0.0432*** (-6.332)	-0.0216*** (-6.4375)	-0.0735*** (-6.2447)
Fund size _{t-1}	-0.2208*** (-11.2699)	-0.1023*** (-10.1521)	-0.2938*** (-9.3487)
Expense(%) _{t-1}	0.1376*** (8.3478)	0.0736*** (8.5978)	0.3022*** (7.6034)
Turnover(%) _{t-1}	0.0002*** (4.2107)	0.0002*** (11.3311)	0.0005*** (8.6058)
Return _{t-1}	-0.0002** (-2.5314)	0.0002*** (4.8363)	0.0008*** (2.8614)
Sustainable Rating _{t-1}	0.0409*** (8.3202)	0.0252*** (9.8646)	0.0781*** (5.5794)
Morningstar Rating _{t-1}	0.0436*** (7.7493)	0.0258*** (8.5365)	0.0816*** (6.2614)
_cons	3.8729*** (11.5231)	1.7365*** (10.1698)	4.8756*** (9.7859)
Observations	9690	9690	9690
R-squared	0.7831	0.8132	0.7717
Year FE	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes

This table presents the regression results testing whether fund managers with prior work experience in carbon-intensive industries reduce portfolio-level carbon emissions through firm selection. Specifically, we retain only the first-year carbon emissions data of invested firms to isolate the selection effect from monitoring effect. The dependent variables across columns (1) to (3) are the weighted carbon emissions per fund asset for Scope 1, Scope 2, and Scope 3 in fund level, respectively, as same in Table 2. The key independent variable is a dummy indicating whether the fund manager has prior work experience in carbon-intensive industries. All regressions control for lagged fund size, lagged expense ratio, lagged turnover ratio, lagged return, Morningstar rating, and sustainability rating. Year fixed effects and fund fixed effects are included in all specifications. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. All variable definitions are provided in Appendix 1.

Table 4: Monitoring Effect of Fund Managers with Carbon-Intensive Industry Backgrounds

	(1) Climate change	(2) Environment	(3) Other E&S
Work experience _{t-1}	2.4392*** (7.6453)	9.6342*** (13.3096)	17.8841*** (10.6159)
Fund size _{t-1}	-4.1591*** (-19.4367)	-0.0776 (-0.4547)	-1.5726*** (-11.4051)
Expense(%) _{t-1}	-11.581*** (-18.4832)	4.8551*** (3.3138)	-0.3037* (-1.7677)
Turnover(%) _{t-1}	0.029*** (21.4181)	0.0214*** (10.3313)	0.0071*** (6.9741)
Return _{t-1}	-0.1092*** (-10.1696)	-0.3414*** (-72.3064)	-0.0112*** (-8.0384)
Sustainable Rating _{t-1}	-4.8408*** (-23.9043)	-2.9244*** (-15.4481)	1.4594*** (12.3689)
Morningstar Rating _{t-1}	8.2873*** (49.7751)	13.0838*** (65.9961)	0.8708*** (11.9284)
_cons	86.388*** (18.4357)	-23.713*** (-6.9864)	23.8926*** (11.1837)
Observations	33560	33560	33560
R-squared	0.323	0.642	0.2779
Year FE	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes

This table presents the regression results of model managers with high carbon-intensive experience and supporting ratio of ESG related proposals, where Work experience is a dummy variable indicating whether a single-managed mutual fund's manager has carbon-intensive industry experience (equal to 1) or not (equal to 0). The dependent variables across Columns (1) – (3) capture the percentage of proposals supported by the fund, with each column focusing on a different theme: Column (1) reflects support for climate change-related proposals, Column (2) for environment-related proposals, and Column (3) for other environmental and social (E&S) proposals. All regressions control for key fund-level characteristics, including lagged Fund size, Expense ratio, Turnover, Return, Sustainability Rating, and Morningstar Rating. Year fixed effects and fund fixed effects are included in all specifications to control for time trends, unobserved heterogeneity across funds, and manager-specific characteristics, respectively. T-values are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 1.

Table 5: Firm-Level Effect: Do Experienced Fund Managers also reduce the carbon emissions in firm level?

	(1) Log(scope1/revenue)	(2) Log(scope2/revenue)	(3) Log(scope3/revenue)
Firm_ExpManager_Ratio	-0.1283** (-2.2175)	-0.2114*** (-4.7548)	-0.1394*** (-3.4789)
Tobin's q_{t-1}	0.0126*** (3.3088)	0.0142*** (4.8474)	0.0331*** (15.0884)
Cash/Net Asset $_{t-1}$	-0.1982*** (-3.0251)	-0.1939*** (-3.6898)	-0.2465*** (-5.3918)
Leverage $_{t-1}$	0.0000 (0.3903)	0.0002*** (3.1817)	0.0001 (1.4756)
ROE $_{t-1}$	0.0000 (-0.5567)	-0.0001*** (-3.0173)	0.0000 (1.122)
Firm size $_{t-1}$	-0.3578*** (-24.1546)	-0.2985*** (-24.1713)	-0.2433*** (-27.1609)
_cons	5.1741*** (41.098)	4.9571*** (47.4538)	6.1844*** (82.1805)
Observations	38,225	38,263	38,263
R-squared	0.9423	0.9298	0.9715
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

This table reports the firm-level regression results testing the selection channel through which fund managers with carbon-intensive industry experience may influence the firms' carbon emissions of their portfolio. The dependent variable is carbon sensitivity of firm, which is measured by three scopes of carbon emissions divide the firm's revenue. The key independent variable is the percentage of fund managers investing in the firm who have prior work experience in carbon-intensive industries. Control variables include lagged Tobin's q, cash-to-net asset ratio, firm size, leverage, and return on equity (ROE), all measured at the firm level. Year and firm fixed effects are included in all specifications. T-values are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 1.

Table 6: The details of scope 3

	(1) Scope 3 Upstream	(2) Scope 3 Downstream	(3) Scope 3 Investment	(4) Scope 3 Franchises	(5) Scope 3 Leased assets
Firm_ExpManager_Ratio	-0.7956*** (-2.7041)	-0.102 (-0.6111)	-4.5138 (-0.1354)	-0.3947 (-1.2538)	-0.4305 (-0.5316)
Leverage _{t-1}	0.0104** (2.1857)	0.0018 (0.5294)	0.5434** (2.3362)	-0.1128** (-2.5119)	-0.0101 (-0.4026)
ROE _{t-1}	-0.0075** (-2.5339)	-0.0031 (-0.6247)	-0.6965* (-1.9069)	0.1679* (1.7092)	0.0002 (0.0062)
Tobin's q _{t-1}	0.0208** (2.527)	0.1145*** (4.5921)	1.0153 (1.0334)	-0.2638*** (-3.0274)	-0.1105 (-1.5717)
Cash/Net Asset _{t-1}	-0.0873 (-0.6532)	2.2359** (2.0421)	2.324 (0.1276)	9.4182*** (2.7089)	3.1246*** (2.587)
Firm size _{t-1}	-0.0373 (-1.155)	0.2207** (2.4093)	24.5703** (2.29)	0.9967*** (2.8159)	0.0258 (0.0409)
_cons	4.3728*** (15.8601)	-0.9028 (-1.0962)	-139.8659 (-1.597)	-3.6158 (-1.2087)	7.9686 (1.5349)
Observations	48,040	33,764	24,062	24,062	24,062
R-squared	0.3992	0.364	0.6077	0.8963	0.9026
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes

This table presents the regression results examining the relationship between fund managers' prior work experience in carbon-intensive industries and firm-level indirect emissions. The dependent variables several disaggregated Scope 3 emission categories: upstream emissions, downstream emissions, and three downstream subcategories—investment, franchises, and leased assets. All emission intensities are scaled by firm revenue. Firm and year fixed effects are included, and standard errors are clustered at the firm level. All regressions include the same control variables as in the baseline models, and firm and year fixed effects are included. Statistical significance is based on the standard errors reported in parentheses. Standard errors are clustered in firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively. All variables are defined in Appendix 1.

Table 7 Entropy

Panel A: Entropy balancing						
Variable	Treated (Pre)	Control (Pre)	Bias (%) Pre	Treated (Post)	Control (Post)	Bias (%) Post
Leverage	-5.51	0.2	-16.54	-7.2	-7.2	0
ROE	-2.84	1.72	-8.99	-6.91	-6.91	0
Tobin's Q	1.4	1.53	-6.15	1.8	1.8	0
Cash	0.1	0.09	6.37	0.12	0.12	0
Size	10.12	8.76	79.48	9.27	9.27	0
Panel B: Regression after Entropy matching						
	(1)	(2)	(3)			
	Log (Scope 1/revenue)	Log (Scope 2/revenue)	Log (Scope 3/revenue)			
Firm_ExpManager_Ratio	-0.183*** (-2.8633)	-0.2023*** (-4.0591)	-0.156*** (-3.4467)			
Leverage _{t-1}	0.000 (-0.0668)	0.0002** -2.5296	0.0001 -0.5734			
ROE _{t-1}	0.000 (-0.1308)	-0.0001*** (-3.072)	0.000 -1.2085			
Tobin's q _{t-1}	0.0118*** -3.0761	0.0141*** -4.8009	0.0329*** -15.0031			
Cash/Net Asset _{t-1}	-0.1876*** (-2.8428)	-0.2088*** (-3.937)	-0.2465*** (-5.3353)			
Firm size _{t-1}	-0.3455*** (-22.8799)	-0.2965*** (-23.5352)	-0.2376*** (-26.2434)			
_cons	5.2406*** (41.0422)	5.0349*** (47.4891)	6.2624*** (82.7987)			
Observations	36,353	36,388	36,388			
R-squared	0.9328	0.9201	0.9664			
Year FE	Yes	Yes	Yes			
Firm FE	Yes	Yes	Yes			
Weights	Entropy	Entropy	Entropy			

This table reports the results of the entropy balancing estimation. Panel A shows the covariate balance before and after weighting. The treated group includes firm-year observations where a firm is invested by a fund manager with prior work experience in carbon-intensive industries. The control group comprises firm-years invested by managers without such experience. The pre-treatment differences in key firm characteristics, including leverage, ROE, Tobin's Q, cash holdings, and firm size, are substantially reduced to zero after applying entropy weights, confirming successful covariate balancing. Panel B presents regression results of the impact of fund managers' carbon-intensive industry experience on firm-level carbon emissions across three scopes, using entropy-weighted observations. The dependent variable is the log of Scope 1, Scope 2, or Scope 3 greenhouse gas (GHG) emissions, normalized by revenue. The key explanatory variable is the firm with how many proportion of fund managers with prior work experience in carbon-intensive industries. All regressions include firm and year fixed effects, and control for firm leverage, profitability (ROE), Tobin's Q, cash holdings, and firm size. Standard errors are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Difference-in-differences matching estimator.

Panel A: Post-match difference				
	Treatment	Control	%bias	t-stat
ROE	0.8980	3.8787	-5.6	-1.53
Tobin's q	1.8107	1.7881	1.2	0.23
Cash/Net asset	0.0988	0.1017	-2.8	-0.55
Leverage	-1.4139	0.0354	-6.0	-1.16
Firm_size	9.9703	9.9746	-0.3	-0.05

Panel B: Difference- in-difference estimator				
	Log (Scope 1/revenue)	Log (Scope 2/revenue)	Log (Scope 3/revenue)	
Manager replacement*Post	-0.2174*** (-3.0752)	-0.1535** (-2.1169)	-0.1912*** (-2.6221)	
Leverage _{t-1}	0.0047* (1.899)	0.0042* (1.7541)	0.005* (1.8948)	
ROE _{t-1}	-0.0035** (-2.1411)	-0.0034** (-2.1793)	-0.0038** (-2.228)	
Tobin's q _{t-1}	-0.1375*** (-5.2212)	-0.1331*** (-5.3339)	-0.1475*** (-5.3686)	
Cash/Net Asset _{t-1}	1.2938** (2.3645)	0.9796** (2.1865)	1.0236** (2.0614)	
Firm size _{t-1}	-0.739*** (-9.2355)	-0.7961*** (-10.6644)	-0.8451*** (-10.7896)	
_cons	9.3828*** (11.3483)	9.9772*** (12.9179)	10.7944*** (13.2894)	
Controls	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	
Firm FE	Yes	Yes	Yes	
N	707	707	707	
R squared	.9903	.9897	.9938	

This table reports the difference-in-differences (DID) estimation results based on a matched sample. Panel A presents summary statistics between the treatment and control groups after propensity score matching (PSM), using observable firm-level characteristics from the pre-treatment year. Panel B reports the DID regression estimates, where the dependent variable is the carbon sensitivity, consistent with the baseline specification. The key independent variable is the interaction term *Manager replacement* $\times$ *Post*. *Manager replacement* is an indicator equal to one if the firm is invested by a mutual fund where a fund manager with prior experience in carbon-intensive industries replaces a manager without such experience; it is zero otherwise. *Post* is a time dummy that equals one for all years after the managerial transition, and zero before. The treatment group consists of firms that experience an entry by an experienced fund manager via replacement, while the control group includes firms without such a change. All regressions include the same control variables as in the baseline models, and firm and year fixed effects are included. Statistical significance is based on the standard errors reported in parentheses. Standard errors are clustered in firm level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively. All variables are defined in Appendix 1.

Table 9: Endogeneity test (IV strategy)

	First stage	Second stage		
	(1) Firm_ExpManager er Ratio	(2) Log (Scope 1/revenue)	(3) Log (Scope 2/revenue)	(4) Log (Scope 3/revenue)
Energy_Consumption_per capita	0.9911*** (2.8462)			
Firm_ExpManager_Ratio		-3.3304*** (-3.6988)	-1.0842*** (-3.2146)	-0.1886** (-2.191)
Leverage _{t-1}	0.0001 (0.2109)	0.0225*** (3.485)	0.0037*** (2.6613)	0.0002 (0.3647)
ROE _{t-1}	0.0000 (-0.3404)	-0.0084*** (-2.6783)	-0.0053*** (-5.1738)	-0.0003 (-0.8396)
Tobin's q _{t-1}	-0.0036*** (-2.7897)	-0.0468*** (-4.4776)	-0.0214*** (-4.6718)	0.0045*** (4.5382)
Cash/Net Asset _{t-1}	0.1173** (2.2326)	1.3412*** (5.2412)	0.894*** (8.6234)	-0.1692*** (-6.9176)
Firm size _{t-1}	-0.0334*** (-3.6937)	-0.04 (-0.5573)	0.1106*** (5.0183)	-0.008 (-1.1595)
_cons	0.1043* (1.7359)	0.1866 (0.2206)	0.2463 (1.0101)	4.9441*** (61.1467)
Observations	6,605	6,601	6,606	6,606
R-squared	0.6248	0.7068	0.8701	0.9816
Adj R2	0.6094	0.6943	0.8648	0.9808
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Kleibergen-Paap Wald rk F statistic	8.09*** [0.0045]			
Kleibergen-Paap rk LM statistic	8.95*** [0.0028]			
Cragg-Donald Wald F statistic	12.36			
Stock-Yogo weak ID test	8.96			

This table presents a two-stage least squares (2SLS) regression to address the potential endogeneity of fund manager work experience when examining its effect on firm-level carbon emissions. The key independent variable, Work experience managers%, is defined as the proportion of fund managers investing in firm *i* at time *t* who have prior work experience in high-carbon industries. To instrument for this variable, we use Energy_Consumption_per capita, measured at the U.S. state level. This variable captures the average energy consumption per person and reflects the likelihood that a region has historically hosted more carbon-intensive industrial activity, thus increasing the probability of managers gaining work experience in such sectors. The dependent variables are logarithm of carbon emissions normalized by total firm assets, including Log (Scope 1 / Assets), Log (Scope 2 / Assets), and Log (Scope 3 / Assets). All models include firm and year fixed effects and standard control variables such as leverage, ROE, Tobin's Q, cash holdings, and firm size. T-values are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 1.

Figure 1 Monitoring Effect of Experienced Fund Managers on Scope 1 Carbon Emissions



Figure 1 plots the dynamic pattern of average Scope 1 carbon emissions (in volume) of portfolio companies before and after the entry of fund managers with prior carbon-intensive industry experience. The x-axis denotes the time window in years, which is calculated by the end year of managers holding minus start year of holding, with year 0 representing the first year a company is held by an experienced manager. The y-axis measures the average Scope 1 emissions volume across firms held by such managers.

Figure 2 Monitoring Effect of Experienced Fund Managers on Scope 2 Carbon Emissions

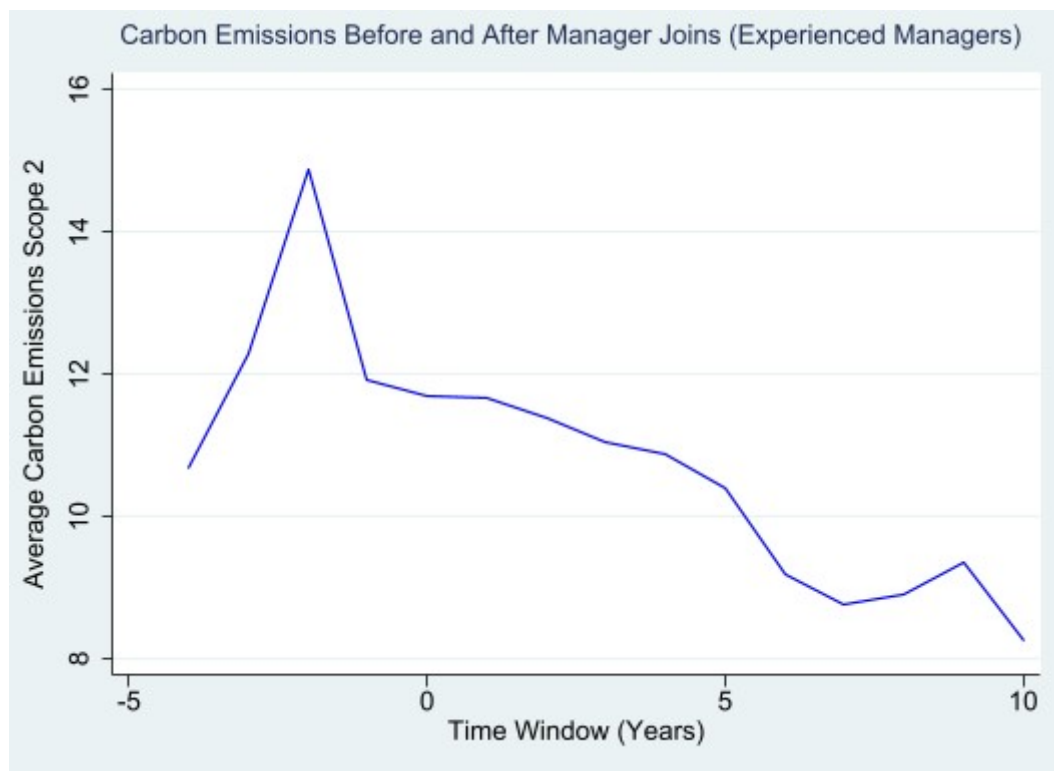


Figure 2 plots the dynamic pattern of average Scope 2 carbon emissions (in volume) of portfolio companies before and after the entry of fund managers with prior carbon-intensive industry experience. The x-axis denotes the time window in years, which is calculated by the end year of managers holding minus start year of holding, with year 0 representing the first year a company is held by an experienced manager. The y-axis measures the average Scope 2 emissions volume across firms held by such managers.

Figure 3 Monitoring Effect of Experienced Fund Managers on Scope 1 Carbon Emissions scope 3



Figure 3 plots the dynamic pattern of average Scope 3 carbon emissions (in volume) of portfolio companies before and after the entry of fund managers with prior carbon-intensive industry experience. The x-axis denotes the time window in years, which is calculated by the end year of managers holding minus start year of holding, with year 0 representing the first year a company is held by an experienced manager. The y-axis measures the average Scope 3 emissions volume across firms held by such managers.

Appendix 1: Definitions of variables.

Notation	Variable name	Measure
Carbon sensitivity (Scope 1)	Carbon emissions fund level	The intensity of carbon emissions scope1 embedded in a fund's holdings, normalized by fund size
Carbon sensitivity (Scope 2)	Carbon emissions fund level	The intensity of carbon emissions scope2 embedded in a fund's holdings, normalized by fund size
Carbon sensitivity (Scope 3)	Carbon emissions fund level	The intensity of carbon emissions scope3 embedded in a fund's holdings, normalized by fund size
Scope1/total asset	Carbon Emissions	The total number scope 1 of carbon emissions over fund size
Scope2/total asset	Carbon Emissions	The total number scope 2 of carbon emissions over fund size
Scope3/total asset	Carbon Emissions	The total number scope 3 of carbon emissions over fund size
Work experience_dummy	Work experience dummy for single managed fund	A dummy variable equalling one if fund manager has work experience related to nature resource
Work experience manager%	Carbon-intensive industry experiences managers percentage	Percentage of fund managers investing in the firm who have prior work experience in carbon-intensive industries
Holding duration	Fund holding duration	Manager's continuous investment years in the firm
Work experience manager%*holding Duration	Work experience manager%*holding Duration	Interaction: prior carbon-intensive industry experience × holding period
Scope 2 (location-based)	Intensity GHG scope 2 location-based:	Greenhouse gas (GHG) emissions from the consumption of purchased electricity, heat, or steam by the company (categorized by the greenhouse gas protocol), relative to the company's revenue. Emissions are calculated using a location-based methodology i.e. using grid emission factors for each region.
Scope 3 upstream	Intensity GHG scope 3 upstream total	Greenhouse gas (GHG) emissions from other upstream activities not covered in scope 2 (categorised by the greenhouse gas protocol) divide by revenue
Scope 3 downstream	Intensity GHG scope 3 downstream total	Total downstream indirect greenhouse gas (GHG) emissions associated with the use of sold goods and services, relative to revenue
Scope 3 investment	Intensity GHG scope 3 investment	Scope 3 downstream greenhouse gas (GHG) emissions from investments relative to revenue. This category covers the operation of investments (including equity and debt investments and project finance), not included in scope 1 or scope 2.
Scope 3 Franchiese	Intensity GHG scope 3 Franchiese	Scope 3 downstream greenhouse gas (GHG) emissions from franchises relative to revenue. This category covers the operation of franchises, not included in scope 1 and scope 2.
Scope 3 leased asset	Intensity GHG scope 3 downstream leased assets	Scope 3 downstream greenhouse gas (GHG) emissions from downstream leased assets relative to revenue. This category covers the operation of assets leased by the reporting company (lessor), not included in scope 1 and scope 2.
Energy_Consumption_per capita	Energy_Consumption_per capita (Million)	Annual per capita energy consumption at the U.S. state level. It serves as a proxy for the local prevalence of carbon-intensive industries and occupations.
Fund level controls		

Expense (%)	Expense ratio	The annual percentage of a fund's assets used to cover management and operational expenses, calculated as total expenses divided by average assets under management (AUM).
Turnover (%)	Turnover ratio	The percentage of a fund's holdings that have been replaced each year, indicating the level of trading activity within the fund.
Fund size	Fund size	Log of net asset value of fund
Fund age	Fund age	The number of years since the fund's inception, reflecting its maturity and experience in the market.
Sustainable Rating	Morningstar Sustainable rating	ESG risk-based fund score (1–5 globes, higher = better)
Morningstar Rating	Morningstar rating	Risk-adjusted performance rating (1–5 stars)
Return	Return of fund	The annual percentage gain or loss generated by the fund, reflecting its investment performance over a specified period.
Firm level controls		
ROE	Return on Equity	Net income as a percentage of total equity
Tobin's q	Growth opportunities	Market value of equity plus total assets minus the book value of equity, all divided by total assets
Cash/net assets	Cash reserves	Cash and cash equivalents divided by net assets
Firm size	Size of firm	Log of total assets
Leverage	Leverage	The sum of short-term and long-term debt divided by total assets

Appendix 2: The results after the PSM

	(1) Log (Scope 1)/revenue	(2) Log (Scope 2)/revenue	(3) Log (Scope 3)/revenue
Firm_ExpManager_Ratio	-0.0189** (-2.356)	-0.0162** (-2.3954)	-0.0309** (-2.4366)
Leverage _{t-1}	0.000 (0.4235)	0.000 (0.4138)	0.000 (0.1244)
ROE _{t-1}	-0.0001*** (-2.6335)	0.000*** (-2.7209)	-0.0001*** (-2.6057)
Tobin's q _{t-1}	-0.011*** (-3.1171)	-0.0094*** (-3.1429)	-0.0171*** (-3.0873)
Cash/Net Asset _{t-1}	-0.4633*** (-6.4491)	-0.3927*** (-6.4769)	-0.6858*** (-6.4729)
Firm size _{t-1}	-0.106*** (-5.9566)	-0.0901*** (-5.9947)	-0.1668*** (-6.1601)
_cons	1.1097*** (6.5229)	0.9502*** (6.6137)	1.7511*** (6.7708)
Observations	957	957	952
R-squared	0.977	0.9862	0.9913
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

t-values are in parentheses

*** $p < .01$, ** $p < .05$, * $p < .1$

