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## Green preference, green investment

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# GREEN PREFERENCE, GREEN INVESTMENT

*Zhenyu Gao, Yan Luo, Shu Tian, and Hao Yang*

**NO. 722**

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## ABSTRACT

Based on Alibaba's renowned "green" initiative, the Ant Forest program, we develop a novel measure to reveal an individual investor's nonpecuniary green preference and link it to an individual's investment actions. We present compelling evidence that supports nonfinancial incentives for investing in green mutual funds while divesting from "brown" funds. Concerns over climate physical and regulatory risks further reinforce this influence. Individuals' green preferences do not lead to financial gains from trading. Moreover, we mitigate the endogeneity issue by employing the development of a local subway network as a source of variations in green preferences.

**Keywords:** nonpecuniary preference, revealed preference, sustainable finance, FinTech

**JEL codes:** G11, G50, Q55

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## 1. Introduction

In her presidential address at the 2023 American Finance Association (AFA) Laura Starks highlights the importance of understanding the motivations behind sustainable finance, particularly the distinction between “value” versus “values” motivations (Starks 2023). Nevertheless, unraveling individuals’ motives for investments poses two major challenges. First, it is difficult to measure individuals’ nonpecuniary preferences toward sustainability and differentiate them from their financial considerations. Second, it is challenging to study how investors’ “green” preferences shape their investment choices.

In this paper, we tackle these challenges by utilizing a revealed preference methodology (Samuelson 1938, 1948) and introducing a novel proxy that unveils nonpecuniary preferences for sustainability among retail investors. We then map this proxy to these investors’ investment decisions. This approach aligns with the theoretical framework presented by Pástor, Stambaugh, and Taylor (2021), who underscore the crucial role of changes in sustainability preferences in driving investors’ demand for green assets and subsequently impacting asset prices, especially during recent periods of heightened public awareness regarding climate and environmental issues. With our proxy, we can effectively track dynamics of individuals’ green tastes and empirically examine the influence of their individual environmental preferences on their green investments.

Our proxy for nonpecuniary preferences for greenness is based on the Ant Forest program, a popular green initiative in the People’s Republic of China (PRC). This program won the United Nations (UN) Champions of the Earth award in 2019, which is the UN’s flagship global environmental honor (UNEP 2019). Operating under the FinTech giant Ant Group, an affiliate of Alibaba, Ant Forest aims to promote sustainable practices among individuals by encouraging them to reduce their carbon footprint and protect the environment in their daily lives. This program is integrated into the Alipay app, the PRC’s largest third-party mobile and online payment platform. It tracks users’ daily eco-friendly activities, such as using public transportation or opting out of single-use cutlery for food deliveries, to promote their green lifestyles. Users can earn “green energy points” for these actions, and once they reach a certain number of points, the Ant Forest program

plants a tree on their behalf and provides real-time satellite images of their trees. Importantly, green energy points cannot be exchanged for financial rewards, therefore the Ant Forest Program reveals an individual's nonpecuniary preference for environmentally friendly practices.

We then link these Ant Forest users' green profiles to their investment portfolios. Since 2014, the Ant Group offered mutual fund distribution services through its Ant Fortune program, which allows investors to easily invest in almost all mutual funds available in the PRC. According to the IPO prospectus of the Ant Group, it is the largest online investment services platform in the PRC, with a total of CNY4,099 billion in assets under management matched and distributed as of 30 June 2020.

We randomly select a sample of 200,000 retail investors who both engage in the Ant Forest program and trade on the Ant Fortune platform via the Alipay app. Our sample period spans from October 2019 to September 2021, and we obtain monthly mutual fund trading and holding data for these investors from the Ant Group, along with data on their Ant Forest green energy points, as well as information about their location, gender, and age. Additionally, we obtained information on the Environmental (E) ratings of the mutual funds from WIND, a widely used financial database in the PRC.

Our baseline results demonstrate that retail investors tend to favor mutual funds with higher E-scores if they earn more green energy points. When we classify the top 20 percent of funds as green funds and the bottom 20% funds as "brown" funds based on their E-scores, we observe that investors who collect more green energy points would invest in green funds and divest from brown funds. These results indicate that investors are more inclined to choose green portfolios when their nonfinancial preferences for eco-friendliness are positively affected.

A crucial concern is that individuals may invest in green funds not solely based on their nonpecuniary preferences. The superior performance of green funds might attract investors, potentially confounding our results. To mitigate this concern, we conduct our empirical analysis at the investor-fund-time level and incorporate fund-time fixed effects into all our regressions. This approach enables us to account for the time-varying

performance of funds, such as returns and risks, as well as other unobservable characteristics that might influence investment decisions due to investors' financial considerations. Furthermore, we include investor fixed effects to control for individual characteristics and focus on the preference dynamics within investors rather than across investors. By including these fixed effects, we can isolate the impact of changing sustainability preferences in driving investors' demand for green funds.

Physical and regulatory risks are regarded as the primary climate risks (Stroebel and Wurgler 2021; Philipp, Sautner, and Starks 2020). In this light, we further investigate the influence of green preferences in shaping the green portfolios of retail investors who have varying exposures to the physical and regulatory impacts of climate change. To capture shocks to investors' physical climate concerns, we utilize abnormal local temperature, following the approach of Choi, Gao, and Jiang (2020). Our analysis indicates that the transition from green preference to green investment is more pronounced for retail investors residing in cities exposed to abnormally high temperatures.

Regulatory risks have a similar effect. We leverage the PRC's proposition of its Dual Carbon Targets (DCT) to capture a time-series shock to climate change awareness of investors related to regulatory risks. We find that retail investors who have earned more green energy points tend to increase their portfolio exposure to green mutual funds following the DCT. This provides further evidence that climate and environmental regulations strengthen the connection between green preferences and investments, highlighting the influence of regulatory risks on investor behavior.

To further validate the nonpecuniary motives of retail investors to invest in green funds, we examine whether the net buying of green funds upon earning more green energy points leads to outperformance. Our analysis indicates that the net purchase of funds with higher E-scores in response to a positive shock to their nonpecuniary preferences does not generate significantly higher returns over 1-, 3-, 6-, and 12-month horizons. This again underscores the role of nonfinancial considerations in green investment.

Last, we perform several robustness and sensitivity tests. While the inclusion of fund-time fixed effects and the non-results of outperformance suggest that financial considerations



may not confound the nonpecuniary motives of green investment, it is important to acknowledge that there could still be unobservable variables that we have not accounted for. For instance, local economic shocks could impact both individuals' environmentally friendly actions in their daily lives and their investment decisions. To mitigate the endogeneity issue, we develop an identification strategy based on the development of a local subway network. This approach employs variations in green energy points accumulation through low-carbon or low-energy consumption modes of travel. The development of a subway network provides individuals with alternative travel options, which could potentially reduce carbon emissions by encouraging the use of public transportation. However, it does not directly affect their investment choices between green and brown funds. By utilizing the development of local subway networks as an instrumental variable, we find that residents in corresponding cities are more likely to amass more green energy points through low-carbon and low-energy green travels. The instrumented green energy points further increase their holding with green funds, ensuring the causal effect of the shock to individual green preferences on their green investment behaviors.

Moreover, we find our results are particularly pronounced for young investors and residents in the cities facing higher levels of air pollution. Our results are also robust using an alternative textual-based measure to identify green funds, after we exclude the sample from cities during the coronavirus disease (COVID-19) pandemic lockdown periods, when we consider a subsample of individuals who redeem green energy points for tree-planting, when we adopt alternative retail trading measures, and when we utilize cumulative green energy points.

Overall, our study provides compelling evidence for the nonpecuniary motivations behind green investment. We develop a novel metric that timely and precisely reveals individuals' nonpecuniary preferences for embracing environmental sustainability and link it to their investment portfolios. We mitigate the endogeneity concerns by introducing a new instrumental variable to identify the role of nonfinancial motives in driving investment decisions. We find that both climate physical and regulatory risk concerns reinforce the

impact of individuals' nonfinancial motives on their green investment and that investment decisions driven by green preferences may not necessarily lead to financial gains.

Our research has noteworthy policy implications. According to the United Nations Framework Convention on Climate Change, the PRC, as the world's largest emerging market, is also the highest emitter of greenhouse gases on a global scale. This fact highlights the importance of our research, which aims to delve into individuals' perceptions of environmental and climate issues, as well as their investment decisions, within the context of the PRC. By gaining a deeper understanding of these aspects, we can contribute to improving our knowledge and strategies in addressing environmental challenges and promoting sustainable practices.

In addition, initiatives such as the Ant Forest program serve as platforms that enable individuals to pay closer attention to environmental issues and track their green actions. These initiatives provide valuable input for policymakers to formulate more effective policies to incentivize individuals to reduce their carbon footprints (He et al. 2023). Our study also highlights the role of digital technology and FinTech in combating climate change and environmental issues. These innovative technologies have the potential to make a significant impact in tackling these pressing global concerns.

The remainder of the paper is structured as follows. Section 2 presents the related literature. Section 3 provides background context on both the Ant Forest program and the Ant Fortune platform offered by the Ant Group. Section 4 describes our data sources and measure constructions. Section 5 presents the main results of our empirical investigation. Section 6 reports the robustness tests. Section 7 concludes.

## **2. Literature Review**

The motivation for this paper stems from the theoretical framework proposed by Pástor, Stambaugh, and Taylor (2021), who model the influence of shifts in sustainability preferences on demand for green assets and asset prices. Empirically, several papers—such as Ardia et al. (2022); Pástor, Stambaugh, and Taylor (2022); and Engle et al. (2020)—measure climate change concerns based on news media. However, rather than

constructing a broad, macro-level index for climate change concerns, our paper takes a different approach. It develops a direct, micro-level measure to capture green preferences for each individual investor and investigates how these shifts in preferences influence their choices regarding green investments.

Our study adds to the literature on nonfinancial determinants of investors' investment decisions. While traditional finance theory suggests that investors care only about risks and returns in making investment decisions, recent studies have presented evidence suggesting that climate and other environmental concerns are also incorporated into investors' investment decisions and are reflected in market prices (e.g., Hong et al. (2019), Alok et al. 2020, Bolton and Kacperczyk 2021, Ilhan et al. 2022). However, most of these studies do not differentiate between investors' financial and nonfinancial incentives. As emphasized in Starks (2023), it is essential to differentiate between value motivations and values motivations in order to address misunderstandings surrounding sustainable finance. To contribute to the existing literature and clarify this distinction, our paper focuses on unraveling investors' nonpecuniary preferences (i.e., values) for their investment decisions.

Studies are now utilizing surveys to gauge beliefs and preferences regarding climate change and, more broadly, environmental, social, and governance (ESG) issues. For instance, Krueger et al. (2020) conclude that institutional investors' consideration of climate risks in investment decisions is driven by both financial and nonfinancial motivations based on a survey conducted among institutional investors. Other studies, such as Giglio et al. (2023), Haber et al. (2022), Anderson and Robinson (2021), and Riedl and Smeets (2017) conduct surveys to capture individual investors' motives for ESG and other socially responsible investments. While surveys have increasingly been used to elicit respondents' preferences and expectations, survey data have several limitations. For example, investors may anticipate high returns from green investment, leading them to claim that they value the environment highly when answering survey questions. Additionally, respondents may not answer survey questions truthfully or carefully, particularly for ethical questions such as their attitudes toward climate change and the environment. Moreover, survey data may not be regularly or frequently collected for the

same respondents, making it difficult to track shifts in their preferences in a timely manner. In this paper, we overcome the limitations of survey data and introduce a novel method to track individuals' nonpecuniary preferences. By studying retail investors' trading decisions conditional on their engagement in daily carbon reduction activities, we provide direct evidence that investors' nonpecuniary motives, such as their moral and ethical obligations toward the environment, play a significant role in influencing their trading decisions.

We also contribute to the fast-growing literature on investors' reactions to climate risks. Several recent papers examine how institutional investors adjust their trading behavior in response to climate risks. For instance, Pástor, Stambaugh, and Taylor (2023); Bolton and Kacperczyk (2021); Gibson et al. (2021); and Choi, Gao, and Jiang (2020) find a declining trend in institutions' exposure to the stocks of high-emission firms in the United States. Boermans and Galema (2019) and Rohleder et al. (2022) document similar evidence for European funds. Our study differs in that it focuses on retail investors' behavior and demonstrates that their nonfinancial green preferences drive their trading decisions, causing them to tilt their portfolios toward green assets such as green mutual funds. Our results additionally show that investors' concerns about climate risks, including physical and regulatory risks, further strengthen the impact of their nonpecuniary green preferences on investment choices.

Furthermore, our study aligns with Choi, Gao, and Jiang (2020) and Choi et al. (2023), who employ local abnormal temperatures and the incidence of local disasters, respectively, to capture investors' perception of climate risks. These studies reveal that retail investors divest from carbon-intensive firms as climate awareness grows. They infer retail trading of a stock at the aggregate level conditional on total institutional ownership of the stock, whereas we investigate actual retail trading data, thereby enabling us to provide more direct evidence at the investor-trade level. Our findings are consistent with theirs, highlighting that retail investors' climate risk awareness affects their trading decisions.

### **3. Institutional Background: Ant Forest and Ant Fortune**

The Ant Group traces its roots back to Alipay, which was established in 2004 to create trust between online sellers and buyers to facilitate trades and payments. Alipay was rebranded as Ant Group Services in October 2014 and further changed its name to Ant Group Co., Ltd. in July 2020.

The Ant Group comprises an entire giant FinTech ecosystem, providing a wide range of services to its users, including online payments, wealth management, microfinancing, credit scoring, and insurance, among others. All these services can be accessed through a single app, Alipay, which is owned and operated by the Ant Group and has attracted a massive number of users over the past decade. According to the IPO prospectus of the Ant Group submitted in 2020, Alipay had 711 million monthly active users and over 1.3 billion annual active users as of June 2020. Alipay surpassed Paypal as the world's most popular mobile payment platform in 2013 and maintains the top spot in 2022, followed by WeChat Pay, Google Pay, and Paypal with a wide margin (Wright 2023). As the PRC's supper app, Alipay is integrated with all kinds of mini-programs and platforms, including Ant Forest and Ant Fortune, which are the focus of our study.

#### **3.1 The Ant Forest Program**

In 2016, the Ant Group launched Ant Forest, a tree-planting mini-program in the Alipay app. This program was initiated to promote green lifestyles by inspiring users to reduce carbon emissions in their daily lives. At its core, Ant Forest encourages users to reduce their carbon footprint through a three-part approach: (i) providing users with individualized carbon savings data direct to their cell phones, (ii) connecting their carbon savings data to green energy points for reduced carbon emissions, and (iii) providing carbon offset rewards through a physical tree-planting program (Green Digital Finance Alliance 2017).

The Ant Forest Program establishes a "carbon account" for each user. This account is one of the three personal accounts embedded in an individual's Alipay app, the other two being the financial account and the credit account. During our sample period, there are 40 ways for individuals to participate in daily eco-friendly activities to earn green energy

points, which could be classified into five major categories: (i) green travel (e.g., travel by public transportations such as subway); (ii) travel reduction (e.g., pay utility bills online); (iii) paper and plastic reduction (e.g., require no plastic packaging); (iv) energy saving (e.g., use energy efficient home appliances); and (v) recycle (e.g., recycle used clothes and shoes).

As Alipay is the dominant digital wallet in the PRC, the Ant Forest program can trace and evaluate the behavior of its users based on transaction data (with users' consent). For instance, when an individual chooses to travel by public transportation or cycling, the program will estimate the carbon emission that could be reduced based on the algorithm provided by the Beijing Environmental Exchange and Nature Conservancy, and reward her green energy points accordingly. In the current reward scheme of the program, a participant could earn 52 grams (g) of green energy points for each subway ride with a daily cap of 296 g, and 18 g of green energy points for riding a shared bike per minute with a daily cap of 159 g.

The green energy points earned will be stored in either the personal Ant Forest account or the carbon account. Once these virtual points have accumulated to a certain amount, they can be spent to instruct Ant Forest to work with local ecological partners to plant trees, conserve a certain area of land for biodiversity, or support poverty-stricken farmers by purchasing local produce from them. And the program participants could see the trees planted or areas protected on their behalf in real-time via satellite. For instance, according to the calculation of Beijing Environmental Exchange, the amount of carbon dioxide that a salt-tolerant shrub can absorb in its lifetime is 17.9 kilograms (kg). Thus, an Ant Forest program participant with 17.9 kg of green energy points could redeem these points for a virtual salt-tolerant shrub on the app, and Ant Forest would match by planting a real salt-tolerant shrub in the desert area of the PRC on her behalf. The idea behind this scheme is that the participant's actions reduce carbon emissions by 17.9 kg, which is equivalent to adding one salt-tolerant shrub to the earth. Note that the green energy points do not benefit Ant Forest users financially, as they can only be redeemed for the program's donations to environmental-protection-related activities such as tree-planting. Yet, the program has gained wide popularity.

The Ant Forest program received the 2019 Champion of the Earth award, the UN's highest environmental honor, by linking people's green behavior to actual forests. The program won this honor not only for making donations to tree-planting and environment preservation. More importantly, by providing nonpecuniary incentives on its digital platform, Ant Forest has induced substantial behavioral changes among individuals. While individuals' limited understanding of climate change and their lack of sense of how to improve the situation result in their low rates of participate in environmental protection activities, the Ant Forest program tackles these issues by visualizing the carbon savings data for participants, virtually simulating the process of caring for seedlings, and enabling participants to see the real-time planting of seedlings through satellite imagery. In such a way, the program evokes individuals' environmental awareness and creates nonpecuniary motives for them to participate in climate change mitigation activities. According to the UN, Ant Forest has become the country's largest private-sector, tree-planting initiative.

### **3.2 The Ant Fortune Platform**

Ant Fortune is an online wealth management platform operated by Ant Group, which collaborates with financial institutions across the PRC. In February 2012, the China Securities Regulatory Commission announced that tech firms independent of fund families, brokers, and banks are allowed to distribute mutual funds on their platforms. Since then, platform mutual fund distribution has become popular in the PRC. As Hong, Lu, and Pan (2023) state, platform distribution benefits both investors and funds with broader participation base. The customer acquisition cost is reduced substantially for funds when more investors join a platform, enabling them to offer great discounts on their subscription rates to investors on the platform. For instance, the subscription rate usually is 1.5% when investors subscribe actively to mutual funds from traditional distribution channels such as commercial banks. If investors choose to subscribe to the same funds on a mutual fund distribution platform, such as Ant Fortune, they can enjoy a subscription rate as low as 0.15%. For investors, as more funds are available on a platform, they can enjoy not only the greatly reduced subscription fee on a platform but also the convenience of managing their entire portfolio on a single platform.

In April 2015, the Ant Group acquired Shumi platform, the mutual fund distribution license of which allowed the group to enter the platform business. According to the IPO prospectus of the Ant Group, by the end of June 2020, it had become the largest online investment services platform in the PRC by assets under management matched and distributed through its platform, which totaled CNY4.1 trillion. It has partnered with approximately 170 asset managers, including the vast majority of mutual fund companies as well as leading insurers, banks, and securities companies in the PRC. Such a wide partnership allows the Ant Group to offer more than 6,000 products through its platform, covering fixed income, equities, and balanced mutual funds.

In 2021, the Asset Management Association of China started to publicize the non-money market mutual fund distribution size by each distribution channel—including banks, brokerage firms, and independent tech and FinTech platforms, among others. The Ant Group ranked first on the list at the end of the first quarter of 2021 with a distribution size of CNY890.1 billion. It maintained its top position and reached a distribution size of CNY1.20 trillion by September 2021, which coincides with the end of our sample period, when it surpassed the second channel (China Merchants Bank) by around 40%, and the third channel (Tiantian Fund Distribution) by over 100%.<sup>1</sup>

#### **4. Data and Measures**

This study was conducted by the Ant Open Research Laboratory in a remote operating interface of Ant Group Environment.<sup>2</sup> All data were sampled and desensitized, and analyzed by the Ant Open Research Laboratory. The laboratory is a sandbox environment where the authors remotely conduct empirical analysis and individual observations are invisible. The main regression variables include basic variables, investment variables, and consumption variables. We combine data from multiple sources. Our sample period spans from October 2019 to September 2021. We randomly select 200,000 retail investors, who have traded at least once during this 24-month sample period, from the online mutual fund distribution platform under the Ant Group (i.e., Ant Fortune). We add

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<sup>1</sup> Asset Management Association of China. Fund Sales Industry Data. <https://www.amac.org.cn/researchstatistics/datastatistics/fundsalesindustrydata/>.

<sup>2</sup> See <https://www.deor.org.cn/labstore/laboratory>.



the trading requirement to assure that non-traders are excluded from this study. The number of unique non-money market funds traded by investors in this initial sample is 7,744, which is compatible with the Ant Group's disclosure in its IPO prospectus that its mutual fund distribution platform offered more than 6,000 products to users at the end of June 2020. And according to the Asset Management Association of China, the average number of non-money market funds during our sample period is around 7,217.<sup>3</sup> Collectively, these statistics confirm that (i) the Ant Fortune covered almost the entire universe of mutual funds in the PRC at the time of our study, and (ii) our sample investors could trade a wide range of funds that are representative of the whole mutual fund market.

To quantify a fund's greenness, we utilize the E (environmental performance) scores provided by Wind, a widely used financial database in the PRC, which offers the most extensive coverage of E-scores for mutual funds. Our methodology results in a total of 3,087,120 trades during the sample period, encompassing 4,414 unique mutual funds that have been assigned E-scores by Wind. Among these funds, 3,053 are mixed funds, 817 are index funds, 543 are equity funds, and 1 is bond fund. (Bond funds typically do not receive E-scores as part of their evaluation.)

In addition, we collect sample investors' demographic information—such as age, gender, and location—from the Ant Fortune platform. For each sample investor, we also obtain her data from Ant Forest, including the monthly green energy points earned and redeemed for environmental protection initiatives (e.g., tree-planting).

For each mutual fund traded by our sample investors during the sample period, we obtain additional information from Wind, including the fund's monthly returns.

#### **4.1 Green Energy Points**

For each retail investor  $i$  in month  $t$ , we obtain the total green energy points granted to them for participating in low-carbon activities. We take the logarithm of one plus the total

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<sup>3</sup> The number of non-money market funds was 5,898 at the end of September 2019 and 8,536 at the end of September 2021. The data can be found at <https://www.amac.org.cn/researchstatistics/datastatistics/mutualfundindustrydata/>.

green energy points earned by investor  $i$  in month  $t$ , and denote it as  $GreenPoint_{it}$ . We expect an investor with a higher  $GreenPoint_{it}$  to have greater green preference.

As mentioned in 2.1, there are 40 ways for individuals to earn green energy points during our sample period, which could be classified into five major categories. For each investor, we obtain not only her monthly total green energy points earned, but also the points earned under each of the five categories.

In the robustness check, we construct an alternative measure for sample investors' green preference,  $Cum\_GreenPoint_{it}$ , which is the cumulative green energy points that investor  $i$  has earned from the beginning of the sample period (October 2019) to the end of month  $t$ . While  $GreenPoint_{it}$  captures an investor's green preference conditional on her participation in daily eco-friendly activities in month  $t$ ,  $Cum\_GreenPoint_{it}$  is constructed conditional on her participation over a longer period. We also set a dummy variable,  $EarlyUser_{i,t}$ , to be one for investor  $i$  if she has joined the Ant Forest program for a period longer than the sample median, and zero otherwise.

## 4.2 Retail Trading

For each retail investor  $i$  in month  $t$ , we calculate her net purchase of each sample mutual fund, which equals the difference between her purchase and sales value of the fund scaled by the sum of the two values and expressed as a percentage:

$$NetBuy_{i,j,t} = (BuyValue_{i,j,t} - SellValue_{i,j,t}) / (BuyValue_{i,j,t} + SellValue_{i,j,t}) \times 100\%. \quad (1)$$

The variable  $NetBuy_{i,j,t}$  conveys information about investor  $i$ 's active trading, and a higher value of the variable indicates investor  $i$ 's greater investment allocation to mutual fund  $j$  in month  $t$ .

For the robustness checks, we construct two alternative measures to capture investor  $i$ 's active trading of fund  $j$ ,  $NetBuy\_Alt1_{i,j,t}$  and  $NetBuy\_Alt2_{i,j,t}$ , using alternative denominators. For  $NetBuy\_Alt1_{i,j,t}$ , we replace the scaler in equation (1) with investor  $i$ 's holdings of fund  $j$  at the end of month  $t-1$ . The scaler for  $NetBuy\_Alt2_{i,j,t}$  is the value of the total fund portfolio holdings of investor  $i$  at the end of month  $t-1$ .

### 4.3 Mutual Funds' Environmental Performance

For each mutual fund traded by sample investors, we obtain its E-score from Wind, which is released on a semiannual basis. The E-score specifically measures a fund's environmental performance, with a higher value indicating better performance.

It is plausible that retail investors are not sophisticated enough to have information on the specific value of the E-score of each fund they trade. Therefore, we set two dummies to capture the salient features of a fund's environmental performance:  $E-Top20\%_{j,t}$  and  $E-Bot20\%_{j,t}$ .  $E-Top20\%_{j,t}$  ( $E-Bot20\%_{j,t}$ ) equals one for fund  $j$  if its E-score is in the top (bottom) 20th percentile in the Wind fund universe, and zero otherwise. Although a retail investor may not know the exact value of a fund's E-score, she is likely to know whether a fund is positioned more toward green ( $E-Top20\%_{j,t} = 1$ ) or brown ( $E-Bot20\%_{j,t} = 1$ ) in the environmental performance spectrum.

The abovementioned environmental performance measures are all constructed based on the environmental score assigned to each fund by Wind. However, it is possible that individual investors may not be aware of or pay sufficient attention to the environmental rating. We therefore propose an additional set of environmental performance measures by conducting textual analysis of the investment philosophy descriptions of each fund. This alternative methodology allows us to effectively capture qualitative information pertaining to the environmental performance of funds.

The investment philosophy section of a fund introduces its investment targets, investment principles, and strategies used to achieve its investment goals. As the investment philosophy section summarizes the important aspects of a fund, in addition to its past performance which is described separately, it is prominently featured on the Ant Fortune app, positioned just below the introduction of the fund manager. The content is excerpted from the fundraising report. The position of this section on the app ensures easy accessibility for investors to read and comprehend.

Based on the investment philosophy section of each mutual fund, we set a dummy variable,  $E-Fund_j$ , which equals one for funds that have referenced the word "environment"

in this section, and zero otherwise. For each fund, we also tally the frequency of occurrences of “environment” in the investment philosophy section, and then scale it by the length of the section. This normalized count is denoted as  $E\text{-Count}_j$ . Funds that discuss environmental issues in their investment philosophy section are arguably demonstrating a heightened focus on these issues. Relative to their counterparts, such funds are more likely to take investment targets’ environmental performance into consideration in constructing their portfolios. We therefore expect a non-zero  $E\text{-Fund}_j$  and a higher  $E\text{-Count}_j$  to be indicative of funds that are greener. To perform placebo tests, we also construct a variable  $S\text{-Fund}_j$  ( $G\text{-Fund}_j$ ), which equals one if the word “social” (or “governance”) is mentioned in the fund’s investment philosophy section, and zero otherwise. Similarly,  $S\text{-Count}_j$  ( $G\text{-Count}_j$ ) is constructed based on the scaled count of “social” (or “governance”) in the investment philosophy section.

To further isolate the green feature of funds, we also identify green funds using a more stringent requirement. We set  $E^\perp\text{-Fund}_j$  to be one only for funds that mention “environment” exclusively in their investment philosophy section, without the mention of “social” or “governance.” For funds with a non-zero  $E^\perp\text{-Fund}_j$ , we further calculate the normalized frequency of occurrences of “environment” in its investment philosophy, in a similar spirit to  $E\text{-Count}_j$ , which is denoted as  $E^\perp\text{-Count}_j$ .  $E^\perp\text{-Count}_j$  is automatically set to be zero for funds with a  $E^\perp\text{-Fund}_j$  that equals zero. By analogy,  $S^\perp\text{-Fund}_j$ ,  $S^\perp\text{-Count}_j$ ,  $G^\perp\text{-Fund}_j$ , and  $G^\perp\text{-Count}_j$  are constructed for placebo tests.

#### 4.4 Physical Impacts of Climate Change

Choi, Gao, and Jiang (2020) demonstrate that investors revise their beliefs about climate change upward and divest carbon-intensive stocks after experiencing warmer-than-usual temperatures. We follow their study to use abnormal local temperature to capture shocks to investors’ green preference brought by heightened physical climate concerns. We obtain city-month level historical temperature data from China Meteorological Administration, and follow Choi, Gao, and Jiang (2020) to construct an abnormal temperature measure,  $AbTmp_{i,t}$ , which is the temperature of the city where investor  $i$  resides in month  $t$  minus the city’s average temperature in the same month of the year

over the past 10 years.<sup>4</sup> A higher  $AbTmp_{i,t}$  is indicative of warmer-than-usual local temperature.

#### 4.5 Regulatory Impacts of Climate Change

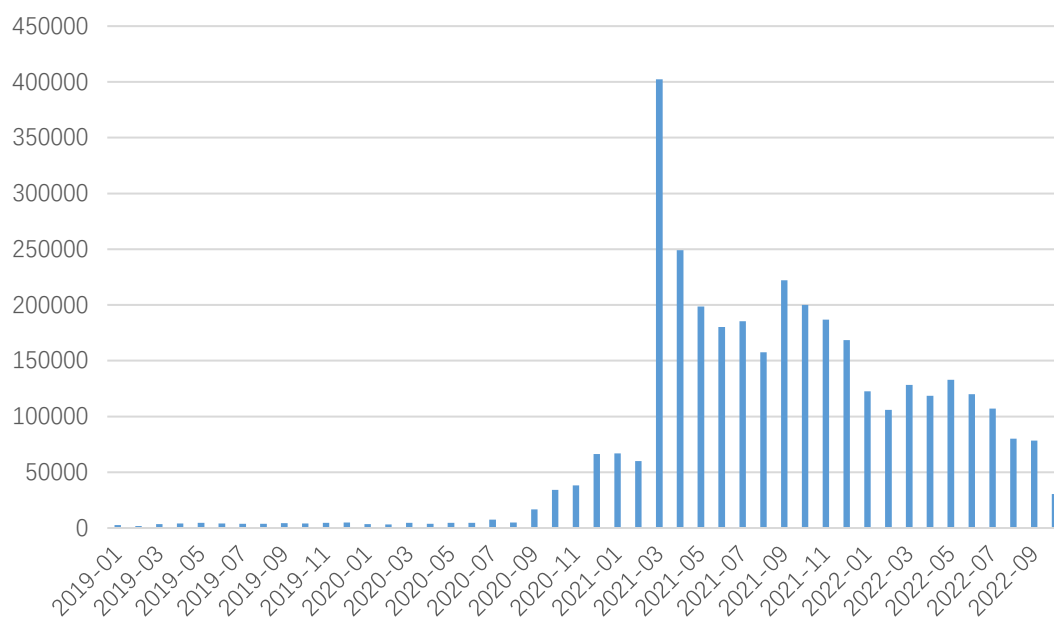
We capture the effect of regulatory impact of climate change using the PRC's proposition of its DCT. The existing literature has suggested that governmental environmental commitment is likely to raise investors' climate-risk awareness. For instance, Seltzer, Starks, and Zhu (2022) and Bolton and Kacperczyk (2021) use the Paris Agreement as a shock to investors' awareness about carbon risk, and show that the carbon premium increases following the Paris Agreement. In a similar spirit, we expect the PRC's proposition of its DCT to boost Chinese investors' climate-risk awareness.

The DCT, the targets of achieving a carbon peak by 2030 and carbon neutrality by 2060, was initially proposed at the 75th UN General Assembly in September 2020. However, the detailed measures and action plans were unveiled in the annual plenary session of the National People's Congress, the top legislature of the PRC, in March 2021. The figure below plots the monthly search volume for the term "carbon neutrality," the ultimate goal outlined in the PRC's DTC proposition, on the country's dominant search engine, Baidu. The search volume for "carbon neutrality" was low when the DCT were initially proposed in September 2020 but surged in March 2021 when the detailed action plans were released. It suggests that the DCT caused much public attention only after the specific measures and action plans were announced. Accordingly, we set March 2021 to be the event month and set a dummy variable  $Post_t$  to be equal to one for all months after the event month.

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<sup>4</sup> More information about the data can be found at <https://data.cma.cn>.

## Search Volume for “Carbon Neutrality” on Baidu



Notes: This figure plots the monthly search volume for “carbon neutrality”, the ultimate goal outlined in the People’s Republic of China’s (PRCO) proposition of the Dual-Carbon Targets (DCT) on Baidu, the dominant search engine in the PRC. The search volume surges in March 2021, coinciding with the PRC’s announcement of detailed measures and action plans for achieving DCT during the annual plenary session of the National People’s Congress, the PRC’s top legislative body.

Source: Authors’ calculations.

## 4.6 Trading Performance

For each investor  $i$ ’s trading of fund  $j$  in month  $t$ , we assess her trading performance 1, 3, 6, and 12 months after the trade. Specifically, we calculate investor  $i$ ’s net purchase, in value of fund  $j$  in month  $t$ , and multiply it by the fund’s return in the following periods:<sup>5</sup>

$$Profit^{1M}_{i,j,t} = (BuyValue_{i,j,t} - SellValue_{i,j,t}) \times Ret_{j,t-t+1}, \quad (2)$$

where  $Profit^{1M}_{i,j,t}$  is the profit that investor  $i$  could obtain one month after her trading of fund  $j$  in month  $t$ ,  $BuyValue_{i,j,t}$  and  $SellValue_{i,j,t}$  are the values of the purchase and sale of

<sup>5</sup> Due to the availability of only 2 years of data on individual investors’ holdings and transactions, we are unable to comprehensively track the dynamics of portfolio performance by considering the timing of buying and selling over an extended period. Therefore, we focus our analysis on the “buy and hold” performance of investors across various time horizons. While this approach provides valuable insights into the investors’ performance within the given timeframe, we acknowledge the limitations imposed by the data availability.

the fund, respectively, and  $Ret_{j,t-t+1}$  is the return of fund  $j$  at 1 month after  $t$ . We similarly calculate  $Profit^{3M}_{i,j,t}$ ,  $Profit^{6M}_{i,j,t}$ , and  $Profit^{12M}_{i,j,t}$ , by replacing  $Ret_{j,t-t+1}$  in equation (2) with  $Ret_{j,t-t+3}$ ,  $Ret_{j,t-t+6}$ , and  $Ret_{j,t-t+12}$ , respectively, which represent the profits that the investor could obtain 3, 6, and 12 months after her trading of fund  $j$  in month  $t$ .

We also assess investors' trading performance based on the abnormal returns of funds being traded. Specifically, we replace  $Ret_{j,t-t+n}$  in equation (2) with the abnormal return of fund  $j$ , which is calculated as its raw return over the  $n$ -month period in excess of its sector return during the concurrent period. The abnormal return that investor  $i$  earns 1, 3, 6, and 12 months after trading fund  $j$  in month  $t$  is denoted as  $AbProfit^{1M}_{i,j,t}$ ,  $AbProfit^{3M}_{i,j,t}$ ,  $AbProfit^{6M}_{i,j,t}$ , and  $AbProfit^{12M}_{i,j,t}$ , respectively.

In investigating the trading performance of investor  $i$  for fund  $j$  in month  $t$ , we control for her historical trading performance in regressions, which reflects her trading ability and might affect our results. The investor's historical trading performance, or  $Investor\_Profit_{i,t}$ , is the cumulated profit that investor  $i$  has earned by trading mutual funds on the Ant Fortune platform from the beginning of the sample period until the end of month  $t$ .

#### 4.7 Instruments Based on Local Subway Development

We propose an instrumental variable for green energy points earned by an individual based on the development of a local subway network. It is natural to expect that an individual living in cities with more developed subway networks will be more aware of and more willing to adopt the low-carbon travel option, which constitutes an important part of her low-carbon lifestyle choices.

In constructing the instrumental variables,  $SubwayStation_{i,t}$  and  $SubwayKms_{i,t}$ , we calculate the ratios of the number of subway stations and the total mileages of subways, respectively, in the city where investor  $i$  resides at the end of month  $t$ , to the city's population at the end of the previous year. The instruments  $SubwayStation_{i,t-1}$  and  $SubwayKms_{i,t-1}$  are expected to be positively correlated with local individuals'  $GreenPoints_{i,t}$  and  $GreenTravel_{i,t}$ . At the same time, these two instruments are less likely

to be directly associated with individuals' green investment decisions, making them suitable instrumental variables for the alleviation of potential endogeneity concerns.

## 5. Empirical Results

In this section, we examine whether an investor's green energy points earned in the Ant Forest program, which is representative of her green preference, would affect her net purchase of mutual funds conditional on the funds' environmental performance. **Table 1** presents the summary statistics of our sample investors and funds. The average age of our sample investor is 33.9 years old, and 44.7% of them are female. The *GreenPoints* of sample retail investors averages 6.99 with a standard deviation of 1.93. The average of the environmental performance score (E-score) of sample mutual funds is 3.01 with a standard deviation of 1.98.

**Table 1: Summary Statistics**

<b>Panel A: Main variables</b>			
Variables	No. Obs.	Mean	Std
<b>Retail trading</b>			
<i>NetBuy</i>	3,087,120	40.8533	83.4425
<i>NetBuy_Alt1</i>	5,468,225	8.2217	0.9628
<i>NetBuy_Alt2</i>	6,204,409	4.2685	32.8742
<b>Investors' demographic information</b>			
<i>Female</i>	3,087,120	0.4471	0.4971
<i>Age</i>	3,087,120	33.8928	9.3290
<b>Green energy points' variables</b>			
<i>GreenPoints</i>	3,087,120	6.9947	1.9266
<i>Cum_GreenPoints</i>	3,087,120	9.5011	2.1836
<i>GreenTravel</i>	3,087,120	6.3534	2.8073
<i>TravelReduction</i>	3,087,120	2.3606	2.7929
<i>P&amp;PReduction</i>	3,087,120	3.5030	1.8682
<i>EnergySaving</i>	3,087,120	0.0577	0.5272
<i>Recycle</i>	3,087,120	0.0552	0.6029
<b>Mutual funds' environmental performance</b>			
<i>E</i>	3,087,120	3.0084	0.9766
<i>E-Top20%</i>	3,087,120	0.1518	0.3588
<i>E-Bot20%</i>	3,087,120	0.1872	0.3901
<b>Other variables</b>			
<i>AbTmp</i>	3,087,120	0.5350	1.2606
<i>Profit-1M</i>	3,087,120	-0.5240	1.2114

*Continued on the next page*



<b>Panel A: Main variables</b>			
Variables	No. Obs.	Mean	Std
<i>Profit-3M</i>	3,087,120	0.0096	1.8588
<i>Profit-6M</i>	3,087,120	0.0274	3.0279
<i>Profit-12M</i>	3,087,120	0.0429	4.1385
<i>AbProfit-1M</i>	3,087,120	-0.0046	1.0146
<i>AbProfit-3M</i>	3,087,120	-0.0045	1.4499
<i>AbProfit-6M</i>	3,087,120	-0.0079	2.3295
<i>AbProfit-12M</i>	3,087,120	-0.0017	2.9700
<i>Investor_Profit</i>	3,087,120	6.6780	28.8767
<i>SubwayStation</i>	3,087,120	126.6060	146.7259
<i>SubwayKms</i>	3,087,120	195.4650	247.5886
<i>Polluted</i>	3,081,662	0.5311	0.4990
<i>EarlyUser</i>	3,087,120	0.5185	0.4997

<b>Panel B: GreenPoints of sample investors by subgroup</b>			
By age	No. Obs.	Mean	Std.
<i>Young</i> (age below median)	1,685,465	7.0608	1.8020
<i>Old</i> (age above median)	1,401,655	6.9153	2.0636
<b>By gender</b>			
<i>Male</i>	1,706,861	7.1389	1.9139
<i>Female</i>	1,380,259	6.8163	1.9272
<b>By the date of joining Ant Forest</b>			
<i>EarlyUser</i> (joining date below median)	1,600,974	7.3482	1.4997
<i>LateUser</i> (joining date above median)	1,486,146	6.6140	2.2378

Notes: Panel A reports summary statistics of the main variables used in the empirical tests. Panel B presents the distribution of green energy points earned by sample investors conditional on age and gender. All variables are defined in the Appendix Table.

Source: Authors' calculations.

## 5.1 Baseline Tests

We perform the baseline test at the investor-fund-year-month level, as specified below:

$$NetBuy_{i,j,t} = \beta_0 + \beta_1 GreenPoints_{i,t-1} \times E_{j,t-1} + \sum_i Investor_i + \sum_{j,t} Fund_j \times Time_t + \varepsilon_{i,j,t}, \quad (3)$$

where retail investor  $i$ 's net purchase of fund  $j$  in month  $t$  is regressed on the interaction term between the green energy points that she earns in month  $t-1$  and the E-score of fund  $j$ . We control for both investor and fund-year-month fixed effects in the tests to isolate the effects of individual heterogeneity or time-varying fund characteristics (e.g., fund returns and risks). The results are reported in **Table 2**.

**Table 2: Green Preference and Trading of Green Funds**

	(1) <i>NetBuy</i> <sub><i>i,j,t</i></sub>	(2) <i>NetBuy</i> <sub><i>i,j,t</i></sub>	(3) <i>NetBuy</i> <sub><i>i,j,t</i></sub>
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E</i> <sub><i>j,t-1</i></sub>	0.2772*** (0.0000)		
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Top20%</i> <sub><i>j,t-1</i></sub>		0.4546*** (0.0002)	
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Bot20%</i> <sub><i>j,t-1</i></sub>			-0.1423** (0.0276)
<i>GreenPoints</i> <sub><i>i,t-1</i></sub>	-2.6628*** (0.0000)	-1.9072*** (0.0000)	-1.8137*** (0.0000)
Investor fixed effects	YES	YES	YES
Fund × Time fixed effects	YES	YES	YES
Adj. R <sup>2</sup>	0.1728	0.1728	0.1728
No. of Obs.	3,087,120	3,087,120	3,087,120

Notes: This table examines the influence of investors' green preference, captured by Ant Forest green energy points, *GreenPoints*<sub>*i,t-1*</sub>, on their trading of mutual funds. The regressions are performed at the investor-fund-time level, with the dependent variable being investor *i*'s net purchase of fund *j* in month *t*, as defined in equation (1). The variable *E*<sub>*j,t-1*</sub> is the most recently available environmental performance score (E-score) of fund *j* provided by Wind. The variables *E-Top20%*<sub>*j,t-1*</sub> and *E-Bot20%*<sub>*j,t-1*</sub> are dummies indicating whether fund *j* is in the top or bottom 20th percentile, respectively, of the fund universe in terms of its E-score. All variables are defined in the Appendix Table. Investor fixed effects and fund-time fixed effects are controlled. Standard errors are clustered at the fund level. The *p*-values are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculations.

The first column of the table shows that the coefficient on the interaction term *GreenPoints*<sub>*i,t*</sub> × *E*<sub>*j,t-1*</sub> is significantly positive at the 1% level. In terms of the economic magnitude, given the sample mean of *GreenPoints*<sub>*i,t*</sub> (6.99) and *Netbuy*<sub>*i,j,t*</sub> (40.85), a 1-point increase in *E* is associated with a 4.7% increase in *Netbuy*<sub>*i,j,t*</sub>. It is consistent with our expectation that investors with more Ant Forest green energy points, which is indicative of her adopting a low-carbon lifestyle and holding a greater green preference, exhibit a stronger inclination to purchase funds with a better environmental performance when making investment decisions.

A potential concern about the E-score is that retail investors may not be sophisticated enough to know the exact value of the score for each sample fund. However, when a fund is positioned toward either end of the spectrum (e.g., extremely green or extremely brown) its environmental performance becomes salient even to retail investors. Thus, we use *E-*

$Top20\%_{j,t-1}$  and  $E-Bot20\%_{j,t-1}$  as alternative measures of a fund's environmental performance. The two variables indicate whether fund  $j$  is in the top or bottom 20th percentile in the fund universe in terms of E-score, respectively. Funds with a non-zero  $E-Top20\%_{j,t-1}$  ( $E-Bot20\%_{j,t-1}$ ) could be viewed as green (brown) funds.

We use  $E-Top20\%_{j,t-1}$  and  $E-Bot20\%_{j,t-1}$  to replace  $E_{j,t-1}$  in equation (3), repeat the tests, and report the results in columns (2) and (3) of Table 2. The results are consistent: Retail investors with more green energy points are more likely to invest in green funds and to divest from brown funds.

Interestingly, the coefficient on  $GreenPoints_{i,t}$  is significantly negative, suggesting that individuals who earn more green energy points are, on average, less inclined to invest in mutual funds. However, these individuals demonstrate a higher propensity to purchase green funds and sell brown funds, resulting in a greener overall portfolio composition.

## 5.2 Breakdown of Green Energy Points

To better understand which type of investors' daily eco-friendly activities best represent their green preference, as reflected in their green investments, we repeat the baseline regression but replace  $GreenPoints_{i,t}$  with each of its five components:  $Greentravel_{i,t}$ ,  $TravelReduction_{i,t}$ ,  $P\&PReduction_{i,t}$ ,  $EnergySaving_{i,t}$ , and  $Recycle_{i,t}$ . **Table 3** reports the results.

**Table 3: Green Preference Revealed through Green Energy Points by Ant Forest Program Activity**

	(1)	(2)	(3)	(4)	(5)	(6)
	$NetBuy_{i,j,t}$	$NetBuy_{i,j,t}$	$NetBuy_{i,j,t}$	$NetBuy_{i,j,t}$	$NetBuy_{i,j,t}$	$NetBuy_{i,j,t}$
$GreenTravel_{i,t-1} \times E_{j,t-1}$	0.1840*** (0.0000)					0.1541*** (0.0000)
$TravelReduction_{i,t-1} \times E_{j,t-1}$		0.0830*** (0.0003)				0.0462** (0.0240)
$P\&PReduction_{i,t-1} \times E_{j,t-1}$			0.1840*** (0.0000)			0.1031*** (0.0005)
$EnergySaving_{i,t-1} \times E_{j,t-1}$				-0.0706 (0.4173)		-0.1320 (0.1748)
$Recycle_{i,t-1} \times E_{j,t-1}$					0.0871 (0.1917)	0.0600 (0.3669)
$GreenTravel_{i,t-1}$	-1.6307*** (0.0000)					-1.4463*** (0.0000)
$TravelReduction_{i,t-1}$		-0.3600***				-0.1894***

Continued on the next page

	(1)	(2)	(3)	(4)	(5)	(6)
	<i>NetBuy</i> <sub><i>i,j,t</i></sub>	<i>NetBuy</i> <sub><i>i,j,t</i></sub>	<i>NetBuy</i> <sub><i>i,j,t</i></sub>	<i>NetBuy</i> <sub><i>i,j,t</i></sub>	<i>NetBuy</i> <sub><i>i,j,t</i></sub>	<i>NetBuy</i> <sub><i>i,j,t</i></sub>
<i>P&amp;PReduction</i> <sub><i>i,t-1</i></sub>		(0.0000)	-1.7003*** (0.0000)			(0.0025) -1.2767*** (0.0000)
<i>EnergySaving</i> <sub><i>i,t-1</i></sub>				1.0518*** (0.0022)		1.2503*** (0.0004)
<i>Recycle</i> <sub><i>i,t-1</i></sub>					-0.2721 (0.2399)	-0.1719 (0.4565)
Investor fixed effects	YES	YES	YES	YES	YES	YES
Fund × Time fixed effects	YES	YES	YES	YES	YES	YES
Adj. R <sup>2</sup>	0.1726	0.1723	0.1725	0.1723	0.1723	0.1728
No. of Obs.	3,087,120	3,087,120	3,087,120	3,087,120	3,087,120	3,087,120

Notes: This table examines the influence of retail investors' green preference on their trading of mutual funds. In columns (1)–(5), green preference is measured by the Ant Forest green energy points earned by investor  $i$  in month  $t-1$  through “green travel” ( $Greentravel_{i,t}$ ), “travel reduction” ( $TravelReduction_{i,t}$ ), “paper and plastic reduction” ( $P\&PReduction_{i,t}$ ), “energy saving” ( $EnergySaving_{i,t}$ ), and “recycle” ( $Recycle_{i,t}$ ), respectively, which constitute the five categories of daily low-carbon lifestyle choices in the Ant Forest program. The regressions are performed at the investor-fund-time level, with the dependent variable being investor  $i$ 's net purchase of fund  $j$  in month  $t$ , as defined in equation (1). The variable  $E_{i,t-1}$  is the most recently available environmental performance score (E-score) of fund  $j$  provided by Wind. All variables are defined in the Appendix Table. Investor fixed effects and fund-time fixed effects are controlled. Standard errors are clustered at the fund level. The  $p$ -values are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculations.

Results in columns (1)–(3) of Table 3 show that when investors' green preference is depicted using their green energy points earned for green travel, travel reduction, or paper and plastic reduction, the green preference is significantly associated with their trading decisions: The coefficients on the interaction terms across the three columns are all significant with magnitudes of 0.184, 0.083, and 0.184, respectively. When investors' green preference is captured by their green energy points earned for energy saving or recycling, as shown in columns (4) and (5) of Table 3, its influence over investors' trading is indistinguishable from zero.

In column (6) of Table 3, we conduct a horse race test. We include investors' green energy points earned for each of these five Ant Forest daily eco-friendly activity categories simultaneously into the regression to estimate the joint effect. Again, the coefficient on the interaction term between investor  $i$ 's green energy points and the E-score of fund  $j$  being traded is significantly positive when the points are earned by green travel, travel reduction, and paper and plastic reduction, but is not significant when the points earned by energy saving or recycling are examined. In terms of the economic magnitude, the effect is the strongest when  $Greentravel_{i,t}$  is examined, which is followed by

$P\&PReduction_{i,t}$  and  $TravelReduction_{i,t}$ . The evidence suggests that  $Greentravel_{i,t}$  contributes the most to the green preference associated with investors' green investments.

### 5.3 Shocks Introduced by Physical or Regulatory Risks

In this section, we provide further evidence on how investors incorporate shocks to their green preferences into investment decisions conditional on their exposure to the physical and regulatory impacts of climate change. The extant literature has suggested that physical and regulatory risks are the top climate risks for investors (Stroebe and Wurgler 2021; Philipp, Sautner, and Starks 2020), we thus expect the link between investors' green preferences and their green investment tendencies to be stronger for those affected by such risks.

#### 5.3.1 Physical Risks

Physical risks are direct risks from the physical changes to the planet as a result of climate change, such as global warming, and are considered the most important climate risk over the next 30 years according to the survey performed by Stroebe and Wurgler (2021). Several studies have shown that investors become more aware of and concerned about climate issues after experiencing physical climate risk (e.g., Choi et al. 2023; Choi, Gao, and Jiang 2020; Anderson and Robinson 2019; and Boermans and Galema 2019). Choi, Gao, and Jiang (2020) show that investors tend to divest from carbon-intensive stocks after experiencing warmer-than-usual temperatures. We follow their study to construct an abnormal temperature measure,  $AbTmp_{i,t}$ , which is the temperature of the city where investor  $i$  lives in month  $t$  minus the city's average temperature in the same month of the year over the past 10 years. We then perform the following regressions to examine the influence of physical risk shocks and report the results in **Table 4**:

$$\begin{aligned}
 NetBuy_{i,j,t} = & \beta_0 + \beta_1 AbTmp_{i,t-2} \times GreenPoints_{i,t-1} \times E_{j,t-1} + \beta_2 GreenPoints_{i,t-1} \times E_{j,t-1} + \beta_3 \\
 & AbTmp_{i,t-2} \times E_{j,t-1} + \beta_4 AbTmp_{i,t-2} \times GreenPoints_{i,t-1} + \beta_5 AbTmp_{i,t-2} + \beta_6 GreenPoints_{i,t-1} + \sum_i \\
 & Investor_i + \sum_{j,t} Fund_j \times Time_t + \varepsilon_{i,j,t},
 \end{aligned} \tag{4}$$

Table 4: Influence of Climate Physical Risk Shock

	(1) <i>NetBuy</i> <sub><i>ij,t</i></sub>	(2) <i>NetBuy</i> <sub><i>ij,t</i></sub>	(3) <i>NetBuy</i> <sub><i>ij,t</i></sub>
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E</i> <sub><i>j,t-1</i></sub> × <i>AbTmp</i> <sub><i>i,t-2</i></sub>	0.0783*** (0.0011)		
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E</i> <sub><i>j,t-1</i></sub>	0.2397*** (0.0000)		
<i>E</i> <sub><i>j,t-1</i></sub> × <i>AbTmp</i> <sub><i>i,t-2</i></sub>	-0.5678*** (0.0021)		
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Top20%</i> <sub><i>j,t-1</i></sub> × <i>AbTmp</i> <sub><i>i,t-2</i></sub>		0.1392** (0.0157)	
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Top20%</i> <sub><i>j,t-1</i></sub>		0.3875*** (0.0039)	
<i>E-Top20%</i> <sub><i>j,t-1</i></sub> × <i>AbTmp</i> <sub><i>i,t-2</i></sub>		-1.0749** (0.0165)	
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Bot20%</i> <sub><i>j,t-1</i></sub> × <i>AbTmp</i> <sub><i>i,t-2</i></sub>			-0.0991* (0.0501)
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Bot20%</i> <sub><i>j,t-1</i></sub>			-0.0874 (0.2196)
<i>E-Bot20%</i> <sub><i>j,t-1</i></sub> × <i>AbTmp</i> <sub><i>i,t-2</i></sub>			0.7963** (0.0394)
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>AbTmp</i> <sub><i>i,t-2</i></sub>	-0.2881*** (0.0002)	-0.0802*** (0.0008)	-0.0403* (0.0674)
<i>AbTmp</i> <sub><i>i,t-2</i></sub>	2.2764*** (0.0001)	0.7726*** (0.0000)	0.4766*** (0.0080)
<i>GreenPoints</i> <sub><i>i,t-1</i></sub>	-2.5251*** (0.0000)	-1.8697*** (0.0000)	-1.7945*** (0.0000)
Investor FE	YES	YES	YES
Fund × Time FE	YES	YES	YES
Adj. R <sup>2</sup>	0.1728	0.1728	0.1728
No. of Obs.	3,087,120	3,087,120	3,087,120

Notes: This table examines the influence of climate physical risk shock, captured by local abnormal temperature, on the translation of investors' green preference into their trading for green funds. *AbTmp*<sub>*i,t-2*</sub> is the abnormal temperature measure constructed following Choi, Gao, and Jiang (2020), which equals the temperature of the city where investor *i* resides in month *t* minus the city's average temperature in the same month of the year over the past 10 years. The regressions are performed at the investor-fund-time level, with the dependent variable being investor *i*'s net purchase of fund *j* in month *t*, as defined in equation (1). *GreenPoints*<sub>*i,t-1*</sub> refers to the Ant Forest green energy points earned by investor *i* during month *t-1*, and *E*<sub>*j,t-1*</sub> is the environmental performance score (E-score) of fund *j* provided by Wind. The variables *E-Top20%*<sub>*j,t-1*</sub> and *E-Bot20%*<sub>*j,t-1*</sub> are dummies indicating whether fund *j* is in the top or bottom 20th percentile, respectively, of the fund universe in terms of its E-score. All variables are defined in the Appendix Table. Investor fixed effects and fund-time fixed effects are controlled. Standard errors are clustered at the fund level. The *p*-values are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculations.

In column (1), the coefficient on the interaction term  $AbTmp_{i,t-2} \times GreenPoint_{i,t} \times E_{j,t-1}$  is significantly positive at the 1% level, confirming that investors' exposure to the physical impacts of climate change reinforces the effect of green preferences on their investment decisions. In columns (2) and (3), we replace  $E_{j,t-1}$  with dummies indicating whether the fund being traded has an E-score in the top or bottom 20th percentiles in the fund universe. Again, the results are confirmative: Investors with a preference for environmentally friendly practices are more inclined to invest in green funds and divest from brown funds following warmer-than-usual local temperatures.

### 5.3.2 Regulatory Risks

To examine the influence of regulatory risks, we capture a time-series, regulatory risk-related shock to investors' climate-change awareness utilizing the PRC's proposition of the DCT. The PRC unveiled specific measures and action plans to achieve its DCT at the annual plenary session of the National People's Congress in March 2021. The surge in that month's search volume for the term "carbon neutrality" on the PRC's largest domestic search engine, Baidu, as illustrated in the figure on page 18, validates the public's heightened attention to the regulatory shock induced by the release of the specific action plans for the DCT. The influence of this regulatory risk is tested using equation (5):

$$NetBuy_{i,j,t} = \beta_0 + \beta_1 GreenPoints_{i,t-1} \times E_{j,t-1} \times Post_t + \beta_2 GreenPoints_{i,t-1} \times E_{j,t-1} + \beta_3 GreenPoints_{i,t-1} \times Post_t + \beta_4 GreenPoints_{i,t-1} + \sum_i Investor_i + \sum_{j,t} Fund_j \times Time_t + \varepsilon_{i,j,t}, \quad (5)$$

where  $Post$  is a dummy that equals one for months after the event month (March 2021), and zero otherwise. The results are reported in **Table 5**. The coefficient on the interaction term between investors' green preference,  $GreenPoints_{i,t-1}$ , and funds' environmental performance measure is significant at the 1% level across all the three columns with predicted signs. The evidence confirms that the link between retail investors' green preferences and their investment decisions became stronger after the regulatory shock induced by the PRC's announcement of its specific DCT action plans at the annual plenary session of the National People's Congress in March 2021.

**Table 5: Influence of Climate Regulatory Risk Shock**

	(1) <i>NetBuy</i> <sub><i>i,j,t</i></sub>	(2) <i>NetBuy</i> <sub><i>i,j,t</i></sub>	(3) <i>NetBuy</i> <sub><i>i,j,t</i></sub>
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E</i> <sub><i>j,t-1</i></sub> × <i>Post</i> <sub><i>t</i></sub>	0.3818*** (0.0000)		
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E</i> <sub><i>j,t-1</i></sub>	0.0254 (0.5819)		
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Top20%</i> <sub><i>j,t-1</i></sub> × <i>Post</i> <sub><i>t</i></sub>		0.8266*** (0.0000)	
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Top20%</i> <sub><i>j,t-1</i></sub>		-0.0141 (-0.9009)	
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Bot20%</i> <sub><i>j,t-1</i></sub> × <i>Post</i> <sub><i>t</i></sub>			-0.3685*** (0.0073)
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>E-Bot20%</i> <sub><i>j,t-1</i></sub>			0.0082 (0.9130)
<i>GreenPoints</i> <sub><i>i,t-1</i></sub> × <i>Post</i> <sub><i>t</i></sub>	-0.4635** (0.0371)	0.6909*** (0.0000)	0.9114*** (0.0000)
<i>GreenPoints</i> <sub><i>i,t-1</i></sub>	-2.1665*** (0.0000)	-2.0910*** (0.0000)	-2.0936*** (0.0000)
Investor FE	YES	YES	YES
Fund × Time FE	YES	YES	YES
Adj. R <sup>2</sup>	0.1729	0.1729	0.1728
No. of Obs.	3,087,120	3,087,120	3,087,120

Notes: This table examines the influence of climate regulatory risk shock, captured by the PRC's unveiling in March 2021 of its measures and action plans to achieve the Dual Carbon Targets (i.e., carbon peak by 2030 and carbon neutrality by 2060), on the translation of investors' green preference into their trading for green funds. The variable *Post*<sub>*t*</sub> is set to one for periods after March 2021, and zero otherwise. The regressions are performed at the investor-fund-time level, with the dependent variable being investor *i*'s net purchase of fund *j* in month *t*, as defined in equation (1). *GreenPoints*<sub>*i,t-1*</sub> refers to Ant Forest green energy points earned by investor *i* during month *t-1*, and *E*<sub>*j,t-1*</sub> is the environmental performance score (E-score) of fund *j* provided by Wind. The variables *E-Top20%*<sub>*j,t-1*</sub> and *E-Bot20%*<sub>*j,t-1*</sub> are dummies indicating whether fund *j* is in the top or bottom 20th percentile, respectively, of the fund universe in terms of its E-score. All variables are defined in the Appendix Table. Investor fixed effects and fund-time fixed effects are controlled. Standard errors are clustered at the fund level. The *p*-values are reported in parentheses. \*, \*\*, and \*\*\* represent significance at 10%, 5%, and 1% level, respectively.

Source: Authors' calculations.

## 5.4 Investment Performance

In all previous tests, we have controlled fund-year-month fixed effects to isolate the influence of funds' past performance on investors' investment decisions, and green energy points still exhibit a strong and robust influence on investors' tendency to invest in funds with a better environmental performance. The evidence supports our conjecture



that nonmonetary motives could be driving the connection between retail investors' preference for green initiatives and their green investments.

We perform additional tests to examine the investment performance of sample retail investors, conditional on their green preference and the environmental performance of the funds being traded. If these investors indeed invest in green funds for nonpecuniary motives, we should observe no significantly positive profits earned by these investors after trading green funds.

Again, we perform investor-fund-month level regressions. For each fund  $j$  traded by investor  $i$  in month  $t$ , we calculate the profits the investor could earn 1, 3, 6, and 12 months after month  $t$ , which are denoted as  $Profit^{1M}_{i,j,t}$ ,  $Profit^{3M}_{i,j,t}$ ,  $Profit^{6M}_{i,j,t}$ , and  $Profit^{12M}_{i,j,t}$ , respectively. We also calculate the abnormal profit that could be earned by investors in a similar way—by only considering fund returns in excess of its sector returns. The abnormal profits measured 1, 3, 6, and 12 months after investor  $i$ 's trading of fund  $j$  in month  $t$  are denoted as  $AbProfit^{1M}_{i,j,t}$ ,  $AbProfit^{3M}_{i,j,t}$ ,  $AbProfit^{6M}_{i,j,t}$ , and  $AbProfit^{12M}_{i,j,t}$ , respectively. The calculation of these profit measures is specified in equation (2) and described in detail in section 4.6. We perform the following regression:

$$Profit_{i,j,t} = \beta_0 + \beta_1 GreenPoint_{i,t} \times E_{j,t-1} + \sum_{i,t} Investor_i \times YearMonth_t + \sum_{j,t} Fund_j \times Time_t + \varepsilon_{i,j,t} \quad (6)$$

where the dependent variable could be one of the six profit measures mentioned above, and the coefficient of interest is  $\beta_1$ . A significantly positive  $\beta_1$  would suggest that investor  $i$  is rewarded financially by investing in fund  $j$ , conditional on its environmental performance, and vice versa.

The results are reported in **Table 6**. Panels A and B of the table use post-trading profit and post-trading abnormal profit as the dependent variable, respectively. The results show that no matter which post-trading interval is examined or how trading profit is measured, retail investors do not earn a significantly positive profit for investing in funds with a better environmental performance. The results render further support to our conjecture that our green preference measure constructed based on retail investors' Ant

Forest green energy points is nonpecuniary in nature and that it is linked to investors' green investment behavior for nonfinancial motives.

**Table 6: Investment Performance**

Panel A	(1)	(2)	(3)	(4)
	$Profit^{1M}_{i,j,t}$	$Profit^{3M}_{i,j,t}$	$Profit^{6M}_{i,j,t}$	$Profit^{12M}_{i,j,t}$
$GreenPoints_{i,t-1} \times E_{j,t-1}$	0.0010 (0.2323)	0.0006 (0.5419)	-0.0010 (0.4882)	0.0001 (0.9745)
$GreenPoints_{i,t-1}$	-0.0042* (0.0719)	-0.0072** (0.0259)	-0.0063 (0.1720)	-0.0158*** (0.0020)
$Investor\_Profit_{i,t}$	-0.0026*** (0.0077)	-0.0078*** (0.0002)	-0.0062** (0.0472)	-0.0061** (0.0498)
Investor FE	YES	YES	YES	YES
Fund $\times$ Time FE	YES	YES	YES	YES
Adj. R <sup>2</sup>	-0.0069	-0.0157	-0.0239	-0.0184
No. of Obs.	3,087,120	3,087,120	3,087,120	3,087,120
Panel B	(1)	(2)	(3)	(4)
	$AbProfit^{1M}_{i,j,t}$	$AbProfit^{3M}_{i,j,t}$	$AbProfit^{6M}_{i,j,t}$	$AbProfit^{12M}_{i,j,t}$
$GreenPoints_{i,t-1} \times E_{j,t-1}$	0.0006 (0.3913)	-0.0004 (0.5611)	-0.0016 (0.1043)	0.0010 (0.1834)
$GreenPoints_{i,t-1}$	-0.0023 (0.2425)	-0.0005 (0.8265)	0.0026 (0.3944)	-0.0042 (0.9880)
$Investor\_Profit_{i,t}$	-0.0013* (0.0847)	-0.0016 (0.1401)	0.0002 (0.9336)	0.0011 (0.4427)
Investor FE	YES	YES	YES	YES
Fund $\times$ Time FE	YES	YES	YES	YES
Adj. R <sup>2</sup>	-0.0104	-0.0241	-0.0303	-0.0283
No. of Obs.	3,087,120	3,087,120	3,087,120	3,087,120

Notes: This table assesses the post-trading performance of investors conditional on their green preference captured by Ant Forest green energy points  $GreenPoints_{i,t-1}$ , and the environmental performance of funds being traded captured by the E-score  $E_{j,t-1}$ . The regressions are performed at the investor-fund-time level. The dependent variable  $Profit^{1M}_{i,j,t}$  in column (1) of Panel A is the profit that investor  $i$  could obtain one month after her trading of fund  $j$  in month  $t$ , as specified in equation (2). Similarly, we assess the profits she could obtain 3, 6, and 12 months after the trading, which are used as the dependent variables in columns (2)–(4), respectively. In Panel B, the dependent variables are the abnormal profits that investor  $i$  could obtain 1, 3, 6, and 12 months after trading fund  $j$  in month  $t$ , where the fund's abnormal return is calculated relative to the concurrent average return of funds in its sector. The variable  $E_{j,t-1}$  is the most recently available environmental performance score (E-score) of fund  $j$  provided by Wind.  $Investor\_Profit_{i,t}$  is the cumulated profit that investor  $i$  has earned through trading mutual funds on the Ant Fortune platform by the end of month  $t$ . All variables are defined in the Appendix Table. Investor fixed effects and fund-time fixed effects are controlled. Standard errors are clustered at the fund level. The  $p$ -values are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculations.

## 5.5 Addressing Endogeneity

As discussed in section 4.7, subway development is closely related with local residents' green travel tendency, yet is less likely to directly affect their investment decisions toward green portfolios. It is thus a suitable instrumental variable for local individuals' green energy points. We use  $SubwayStation_{i,t}$  and  $SubwayKms_{i,t}$ , which are the scaled city-level number of subway stations and subway mileage, respectively, as instruments for local investors' green energy points,  $GreenPoints_{i,t}$ , and their points specifically earned for green travel,  $GreenTravel_{i,t}$ .

We estimate the following two-stage equations:

$$GreenPoints_{i,t} (GreenTravel_{i,t}) = \beta_0 + \beta_1 SubwayStation_{i,t-1} (SubwayKms_{i,t-1}) + \sum_i Investor_i + \sum_t Time_t + \varepsilon_{i,t}, \quad (7)$$

$$NetBuy_{i,j,t} = \beta_0 + \beta_1 Pre (GreenPoints_{i,t-1} (GreenTravel_{i,t-1})) \times E_{j,t-1} + \sum_i Investor_i + \sum_{j,t} Fund_j \times Time_t + \varepsilon_{i,j,t}, \quad (8)$$

where  $Pre (GreenPoint_{i,t-1})$  and  $Pre (GreenTravel_{i,t-1})$  in equation (8) is the predicted value of investor  $i$ 's  $GreenPoints$  and  $GreenTravel$  in month  $t-1$  estimated using equation (7).

**Table 7** reports the results of the two-stage regressions.

**Table 7: Local Subway Development as Instrumental Variables**

Panel A: 1st stage	(1) $Greenpoint_{i,t}$	(2) $Greenpoint_{i,t}$	(3) $GreenTravel_{i,t}$	(4) $GreenTravel_{i,t}$
$SubwayStations_{i,t-1}$	0.0021*** (0.0000)			
$SubwayKms_{i,t-1}$		0.0012*** (0.0001)		
$SubwayStations_{i,t-1}$			0.0032*** (0.0000)	
$SubwayKms_{i,t-1}$				0.0016*** (0.0003)
Investor FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
F statistic	23.065	14.825	26.446	13.038
Adj. R <sup>2</sup>	0.7233	0.7233	0.7586	0.7586
No. of Obs.	3,087,120	3,087,120	3,087,120	3,087,120

Continued on the next page

Panel B: 2nd stage	IV = Stations	IV = KMs	IV = Stations	IV = KMs
	(1)	(2)	(3)	(4)
	<i>NetBuy</i> <sub><i>i,j,t</i></sub>	<i>NetBuy</i> <sub><i>i,j,t</i></sub>	<i>NetBuy</i> <sub><i>i,j,t</i></sub>	<i>NetBuy</i> <sub><i>i,j,t</i></sub>
<i>Pre (GreenPoints</i> <sub><i>i,t-1</i></sub> ) × <i>E</i> <sub><i>j,t-1</i></sub>	6.9409*** (0.0020)	7.5156*** (0.0029)		
<i>Pre (GreenPoints</i> <sub><i>i,t-1</i></sub> )	-21.610 (0.2450)	-9.3446*** (0.6842)		
<i>Pre (GreenTravel</i> <sub><i>i,t-1</i></sub> ) × <i>E</i> <sub><i>j,t-1</i></sub>			4.5356*** (0.0020)	5.5920*** (0.0029)
<i>Pre (GreenTravel</i> <sub><i>i,t-1</i></sub> )			-14.121 (0.2450)	-6.9529 (0.6842)
Investor FE	YES	YES	YES	YES
Fund × Time FE	YES	YES	YES	YES
Adj. R <sup>2</sup>	0.1723	0.1723	0.1723	0.1723
No. of Obs.	3,087,120	3,087,120	3,087,120	3,087,120

Notes: This table presents the findings of tests conducted using instrumental variables. The two instrumental variables are *SubwayStations*<sub>*i,t-1*</sub> and *SubwayKms*<sub>*i,t-1*</sub>, which represent the number of subway stations and the total mileages of subways at the end of month *t-1* in the city where investor *i* resides, scaled by the city's population at the end of the previous year, respectively. *Greenpoint*<sub>*i,t*</sub> denotes the total green energy points that investor *i* earns in the Ant Forest program in month *t*, and *GreenTravel*<sub>*i,t*</sub> is the green energy points she earns specifically for green travel, one of the five categories of daily low-carbon lifestyle choices in the Ant Forest program. Panels A and B report results of the first- and second-stage tests, respectively. In Panel B, the regressions are performed at the investor-fund-time level, with the dependent variable being investor *i*'s net purchase of fund *j* in month *t*, as defined in equation (1). *Pre (GreenPoints* <sub>*i,t-1*</sub>) in columns (1) and (2) is the predicted value from columns (1) and (2) in Panel A, respectively. *Pre (GreenTravel* <sub>*i,t-1*</sub>) in columns (3) and (4) is the predicted value from columns (3) and (4) in Panel A, respectively. The variable *E*<sub>*j,t-1*</sub> is the most recently available environmental performance score (E-score) of fund *j* provided by Wind. All variables are defined in the Appendix Table. Investor fixed effects and fund-time fixed effects are controlled. Standard errors are clustered at the fund level. The *p*-values are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculations.

Panel A shows the results of the first-stage regression. Across all four columns, the instrumental variables *SubwayStations*<sub>*i,t-1*</sub> and *SubwayKms*<sub>*i,t-1*</sub> are significantly and positively associated with *GreenPoints*<sub>*i,t*</sub> or *GreenTravel*<sub>*i,t*</sub> at the 1% level. The result in column (1) suggests that a one standard deviation increase in *SubwayStation*<sub>*i,t-1*</sub> would contribute to a 4.4% increase in *GreenPoints*<sub>*i,t*</sub> relative to the sample mean (6.99). The *F*-statistics across all four columns are greater than 10, confirming that the number of local subway stations and subway mileage are not considered weak instruments for *GreenPoints* and *GreenTravel* of local investors.

Panel B reports the results of the second-stage regression. The coefficient on the interaction term between retail investors' instrumented *GreenPoints* or *GreenTravel* and fund environmental performance is significantly positive at the 1% level across all four columns. The results render further support to our conjecture that retail investors' green preference, revealed through their participation in daily eco-friendly activities, plays a role in shaping their investment preference.

## **6. Conclusions**

Our research builds on the success of the Ant Forest program, a well-known green initiative in the PRC. By using a new measure that reflects how individuals strengthen their nonpecuniary preferences with regard to environmental issues, we map this measure to their investment decisions. This approach provides compelling evidence of the nonfinancial drivers behind green investing. To address the challenge of endogeneity, we use the development of a local subway network as an instrumental variable, which causes variations in the accumulation of green energy points through eco-friendly travel. Our findings emphasize the strong impact of nonfinancial incentives on green investment decisions, including how individual concerns over the physical and regulatory risks of climate change further strengthen these incentives. Although individuals may update their nonmonetary green preferences, our research suggests that these updates may not necessarily generate financial gains from trading.

## Appendix Table: Variable Definitions

Variables	Definitions
<b>Retail trading</b>	
<i>NetBuy<sub>i,j,t</sub></i>	The difference between investor <i>i</i> 's purchase and sales value of fund <i>j</i> in month <i>t</i> scaled by the sum of the two values. The variable is defined in equation (1) and expressed in percentage.
<i>NetBuy_Alt1<sub>i,j,t</sub></i>	The difference between investor <i>i</i> 's purchase and sales value of fund <i>j</i> in month <i>t</i> scaled by the value of fund <i>j</i> in her portfolio at the end of month <i>t</i> -1. The variable is expressed as a percentage.
<i>NetBuy_Alt2<sub>i,j,t</sub></i>	The difference between investor <i>i</i> 's purchase and sales value of fund <i>j</i> in month <i>t</i> scaled by the total value of her fund portfolio at the end of month <i>t</i> -1. The variable is expressed as a percentage.
<b>Retail investors' demographic information</b>	
<i>Young<sub>i</sub></i>	An indicator that equals one for retail investors aged below the sample median (32 years) at the beginning of the sample period, and zero otherwise.
<i>Age<sub>i</sub></i>	Retail investors' age at the beginning of the sample period.
<i>Female<sub>i</sub></i>	An indicator that equals one for female investors and zero for male investors.
<b>Ant Forest program-related variables</b>	
<i>GreenPoint<sub>i,t</sub></i>	The logarithm of one plus the total green energy points earned by investor <i>i</i> in month <i>t</i> in the Ant Forest program.
<i>Cum_GreenPoint<sub>i,t</sub></i>	The logarithm of one plus the cumulative green energy earned by investor <i>i</i> from the beginning of the sample period until the end of month <i>t</i> .
<i>GreenTravel<sub>i,t</sub></i>	The logarithm of one plus the green energy earned by investor <i>i</i> under the "green travel" category in the Ant Forest program, through activities such as traveling by public transportation and walking.
<i>TravelReduction<sub>i,t</sub></i>	The logarithm of one plus the green energy points earned by investor <i>i</i> under the "travel reduction" category in the Ant Forest program, through activities such as using online services.
<i>P&amp;PReduction<sub>i,t</sub></i>	The logarithm of one plus the green energy points earned by investor <i>i</i> under the "paper and plastic reduction" category in the Ant Forest program, through activities such as requiring no single-use cutlery for food-delivery services and requiring electronic receipts instead of printed copies.
<i>EnergySaving<sub>i,t</sub></i>	The logarithm of one plus the green energy points earned by investor <i>i</i> under the "energy saving" category in the Ant Forest program, through activities such as purchasing energy-efficient appliances.
<i>Recycle<sub>i,t</sub></i>	The logarithm of one plus the green energy points earned by investor <i>i</i> under the "recycle" category in the Ant Forest

Continued on the next page

<b>Variables</b>	<b>Definitions</b>
	program, through activities such as recycling used clothes, cell phones, and appliances.
$EarlyUser_{i,t}$	An indicator that equals one if, by the end of month $t$ , investor $i$ has joined the Ant Forest program for a period longer than the sample median, and zero otherwise.
<b>Mutual funds' environmental performance based on ratings</b>	
$E_{j,t}$	The E-score, issued by Wind, of fund $j$ , conditional on its environmental performance. The score is updated on a semi-annual basis.
$E-Top20\%_{j,t}$	A dummy variable that equals one if the E-score of fund $j$ is in the top 20th percentile of the fund universe with Wind E-scores, and zero otherwise.
$E-Bot20\%_{j,t}$	A dummy variable that equals one if the E-score of fund $j$ is in the bottom 20th percentile of the fund universe with Wind E-scores, and zero otherwise.
<b>Mutual funds' nonfinancial performance based on textual analysis</b>	
$E-Fund_j$	An indicator that equals one for fund $j$ if it mentions "environment" in its investment philosophy, which is excerpted from its fundraising report and displayed in the Ant Fortune app, and zero otherwise.
$E-Count_j$	The number of times that "environment" is mentioned in the investment philosophy section of fund $j$ displayed in the Ant Fortune app, scaled by the length of the section.
$S-Fund_j$	An indicator that equals one for fund $j$ if it mentions "social" in its investment philosophy section displayed in the Ant Fortune app, and zero otherwise.
$G-Fund_j$	An indicator that equals one for fund $j$ if it mentions "governance" in its investment philosophy section displayed in the Ant Fortune app, and zero otherwise.
$S-Count_j / G-Count_j$	The construction is analogous to that of $E-Count_j$ .
$E^\perp-Fund_j$	An indicator that equals one for fund $j$ if it mentions "environment" in its investment philosophy section displayed in the Ant Fortune app but does not mention "social" or "governance," and zero otherwise.
$E^\perp-Count_j$	The number of times that "environment" is mentioned in the investment philosophy section of fund $j$ , scaled by the length of the section, conditional on $E^\perp-Fund_j$ not being zero. $E^\perp-Count_j$ is set zero if $E^\perp-Fund_j$ equals zero.
$S^\perp/G^\perp-Fund_j$	The construction is analogous to that of $E^\perp-Fund_j$ .
$S^\perp/G^\perp-Count_j$	The construction is analogous to that of $E^\perp-Count_j$ .
<b>Physical- and regulatory-shock-related variables</b>	
$AbTmp_{i,t}$	The abnormal temperature measured following Choi, Gao, and Jiang (2020), which equals the temperature of the city where investor $i$ resides in month $t$ minus the city's average temperature in the same month of the year over the past 10 years.
$Post_t$	A dummy variable that equals one for months after March 2021, and zero otherwise. In March 2021, the PRC unveiled

Continued on the next page

Variables	Definitions
	its measures and action plans to achieve the Dual Carbon Targets in the annual plenary session of the National People's Congress, the top legislature in the PRC.
<b>Post-trading performance</b>	
$Profit_{i,j,t}^{1M}$ $Profit_{i,j,t}^{3M}$ $Profit_{i,j,t}^{6M}$ $Profit_{i,j,t}^{12M}$	$Profit_{i,j,t}^{1M}$ is the profit that investor $i$ could obtain 1 month after her trading of fund $j$ in month $t$ . It is calculated by multiplying investor $i$ 's net purchase of fund $j$ (unscaled) in month $t$ by fund return 1-month after $t$ , as specified in equation (2). By analogy, we also construct performance measures for 3, 6, and 12 months after the trading, which are denoted as $Profit_{i,j,t}^{3M}$ , $Profit_{i,j,t}^{6M}$ , and $Profit_{i,j,t}^{12M}$ , respectively.
$AbProfit_{i,j,t}^{1M}$ $AbProfit_{i,j,t}^{3M}$ $AbProfit_{i,j,t}^{6M}$ $AbProfit_{i,j,t}^{12M}$	$AbProfit_{i,j,t}^{1M}$ is the abnormal profit that investor $i$ could obtain one month after her trading of fund $j$ in month $t$ . It is calculated by multiplying investor $i$ 's net purchase of fund $j$ (unscaled) in month $t$ by the abnormal return of fund $j$ 1 month after $t$ . The abnormal return of fund $j$ is its return over the average return of funds in its sector during the concurrent period. By analogy, we also construct abnormal performance measures for 3, 6, and 12 months after the trading, which are denoted as $AbProfit_{i,j,t}^{3M}$ , $AbProfit_{i,j,t}^{6M}$ , and $AbProfit_{i,j,t}^{12M}$ , respectively.
$Investor\_Profit_{i,t}$	The cumulated profit that investor $i$ has earned through trading mutual funds on the Ant Fortune platform from the beginning of the sample period until the end of month $t$ .
<b>City characteristic</b>	
$Polluted_i$	A dummy variable that equals one for the city where investor $i$ lives if its average monthly $PM_{2.5}$ concentration is above the median of all cities in the PRC in 2018, and zero otherwise.
<b>Instrumental variables</b>	
$SubwayStations_{i,t}$	The number of subway stations of the city where retail investor $i$ lives in month $t$ , scaled by the city's resident population at the end of the previous year.
$SubwayKms_{i,t}$	The total mileage of subways in the city where retail investor $i$ lives in month $t$ , scaled by the city's resident population at the end of the previous year.

PRC = People's Republic of China.

Source: Authors' compilation.



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## **Green Preference, Green Investment**

This paper examines whether individual investors' green preference will be reflected in their investment decisions. It provides compelling evidence that individuals with stronger green preference invest more in green mutual funds, influenced by concerns over the physical and regulatory risks of climate change. It suggests that this behavior is not driven by financial incentives as preference-related investments may not always lead to financial gains from trading.

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