Retail Investors' Activity on Pleasant and Unpleasant Firms

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Abstract

This study investigates whether retail investors trade depending on a firm's exposure to extreme temperatures as a proxy for physical climate risks. We define pleasant (P), unpleasant hot (UH), and cold (UC) firms as those firms *without* and *with* exposure to such events. Retail trading in both pleasant and unpleasant firms is in the right direction on average, yet their trading in UC and UH firms weakens and strengthens their imbalances' positive predictability for certain future returns. We document that while the performance of a trading strategy relying on UC firms is higher in the short run than that of P and UH firms, the P strategy outperforms in the long run. Retail order imbalances of UH and P firms also convey the most substantially positive effects on earnings surprises. Finally, retail investors' activity in pleasant and unpleasant firms leads to comovement in their return and imbalance levels.

JEL Codes: G11, G12, G14, Q50.

Keywords: Retail Investors; Pleasant Firms; Unpleasant Firms; Return Predictability.

1 Introduction

Do retail investors trade depending on a firm's exposure to weather? Climate impacts, such as increasing temperatures, are more prominent and evident, affecting firms' returns and amplifying the awareness of climate change (Cuculiza et al., 2024; Bortolan et al., 2022; Choi et al., 2020; Makridis and Schloetzer, 2023). Several studies show that firms' exposure to extremely high temperatures also adversely affects earnings (Addoum et al., 2023; Cuculiza et al., 2021; Hugon and Law, 2019), equity valuations (Bansal et al., 2019) and reduces revenues and operating income at the firm level (Pankratz et al., 2023) and global supply-chains (Pankratz and Schiller, 2024).[1] Yet, despite this large body of literature on climate change's impacts and scientists' consensus, little is known about whether retail investors' trading decisions reflect these risks, as measured by firms' exposure to extreme temperatures. Understanding such retail trading activity and how it can influence stock prices is especially relevant given the above evidence and the 2024 Securities and Exchange Commission's (SEC) climate disclosure rule, requiring publicly traded companies to increase their disclosures on climate risks, including those from extreme weather.[2]

This study uses extreme temperatures, e.g., hot and cold, as proxies for physical climate risks to assess and better understand whether retail investors' activity varies in firms *with* exposure to such unpleasant weather.[3] Aside from separately considering their trading in unpleasant hot (UH) and

[1] In addition, Bansal et al.'s (2019) theoretical model predicts that climate change due to rising temperatures also adversely influences the economy, such that assets with high exposure to temperature also display high growth risks. Thus, *"...temperature is a source of long-run economic risks and underscores the importance of forward-looking capital markets for understanding the impact and cost of climate change."* Alike, Natoli (2023) documents that unfavorable temperatures reduce the GDP, consumer prices, and interest rates. For an excellent literature survey on i) weather's effects on economic outcomes and ii) weather and climate change risks, see Dell et al. (2014) and Hong et al. (2020), respectively.

[2] For instance, according to S-K and S-X regulations, companies must report the impacts of severe weather events and other natural conditions and the costs of transitioning to sustainability.

[3] Also, it recognizes the difficulty of finding a good proxy for climate change and, thus, physical climate risk. However, given the extensive use of extreme temperature in the existing literature (among others; see Addoum et al. (2023) and Hugon and Law (2019)) and their granular availability across the U.S. and at a daily level, we consider our extreme temperature measures reliably suitable. Brian Deese, Head of Sustainable Investing at BlackRock, also agrees with this; e.g., according to the Financial Times, 4th April 2019 ("BlackRock analysis helps define climate-change risk"), he states that this may be due to climate models not incorporating the "recent acceleration in the frequency and severity of extreme weather events" and the unavailability of precise firm-level data. Choi et al. (2020) reinforce the above, emphasizing that *"extreme local temperatures therefore serve as "wake-up calls" that alert investors to climate change."* Similarly, Alekseev et al. (2022) state, *"Just as local extreme temperatures increase local climate change awareness, U.S.-wide extreme heat events have the potential to drive national awareness."* Along the same lines, Friederike Otto, Head of the Environmental Change Institute at the University of Oxford, highlights, *"Where we really see the clearest and biggest sign of climate change is in extreme temperatures."*

cold (UC) firms, it also includes pleasant (P) firms, i.e., those *without* exposure to such extreme temperatures. To do so, we identify the U.S. retail trades (both purchases and sales) from January 2010 to December 2018 using the well-known sub-penny approach of Boehmer et al. (2021). As for the pleasant and unpleasant weather, relying on the daily minimum and maximum temperatures, we follow Schlenker and Roberts (2009) in computing the degree days above 30°C and below 0°C at the county level (see, e.g., Addoum et al., 2023). When these are zero, we define temperatures as pleasant and otherwise as unpleasant, i.e., hot and cold, respectively.

To this extent, does retail investors' trading vary on pleasant and unpleasant (UH, UC) firms? Our results show that, indeed, it does. Retail investors trade significantly less on unpleasant than pleasant firms, i.e., those firms *with* and *without* exposure to extreme hot and cold temperatures. Moreover, their trading activity also significantly differs between the unpleasant firms, e.g., they trade substantially less in UC than UH firms. This finding highlights the necessity of distinguishing between extremely hot and cold temperatures and, therefore, retail investors' activity in such firms.[4] It also reinforces Blackrock's (2019) concerns that *"Investors who are not thinking about climate-related risks, or who view them as issues far off in the future, may need to recalibrate their expectations."*

The above interesting inferences also prompt us to explore further the distinct role of retail investors' trading in pleasant and unpleasant firms (with less and more noticeable exposure to climate physical risk) in stock pricing and, thus, their potential informativeness for future stock prices. To this end, we document an overall positive relationship between retail order imbalances of pleasant and unpleasant firms and future returns, which i) holds up to ten versus four and two weeks ahead (for the UH and UC firms) and ii) typically is less intense for the former than latter firms. The significant contribution of private information and P firms' price pressure explains most of this relationship. Nonetheless, what is likewise interesting is the different incremental effects of their unpleasant trading on returns. That is, while retail imbalances of UC firms weaken the positive

[4]We acknowledge that some firms may benefit or suffer less from climate change since managers may take actions to tackle it, such as diversifying across regions or products and using weather derivatives to hedge their exposure to extreme temperatures. Indeed, Hugon and Law (2019) document a reduction in the adverse effects of temperature on these firms' earnings and those with a high climate lobbying. Nevertheless, given their limited resources, retail investors may not necessarily own such detailed firm-level information. Instead, if they hold it, we expect them to trade in pleasant and unpleasant firms closely, which our results show is not the case.

predictability for the up to one week ahead returns, those of both UH and UC firms strengthen it for the four and two weeks ahead, respectively. In addition, retail imbalances of pleasant and unpleasant firms positively predict earnings surprises, with the effects of the former being more substantial and holding in the long run, too. These empirical conclusions suggest that although retail investors are usually informed when trading in unpleasant firms, especially the unpleasant cold ones, they are more likely to do so in the wrong direction, i.e., make mistakes in the short run. Indeed, corroborating this conclusion to some extent, our study points out the insignificant high−low (Q5−Q1) portfolio returns for the UC firms. However, the Q4−Q1 returns are positively significant for pleasant and unpleasant firms. Moreover, while the UC trading strategy outperforms the others in the short run, the P strategy dominates in the long run.

Our study offers several contributions. First, our paper contributes to the debate on whether retail investors are informed (Boehmer et al., 2021; Barrot et al., 2016; Kelley and Tetlock, 2013; Kaniel et al., 2008; Kaniel et al., 2012) or not (Barber et al., 2008; Barber and Odean, 2000, 2001, 2008) about future stock returns by separately considering their trading decisions in pleasant and unpleasant hot and cold firms. As such, it aims to understand better the potential variation in the informativeness of these decisions and, thus, the predictive ability of retail trades in pleasant and unpleasant firms for future stock returns. The findings of retail investors being more i) informed about future returns when trading in pleasant firms and ii) likely to trade in the wrong direction, at least in the short term, when trading in unpleasant cold firms provides new and additional evidence on their trading decisions in firms with various exposure to extreme weather events. These also add to the study of Finta (2022), documenting the substantial influence of climate disasters on the predictive power of retail trades on future returns.

Second, we extend the literature on the effects of weather on investors trading behavior and stock markets by showing that U.S. retail investors trade significantly less on unpleasant than pleasant firms (Cuculiza et al., 2021, 2024; Addoum et al., 2020, 2023; Makridis and Schloetzer, 2023; Alekseev et al., 2022; Choi et al., 2020).[5] Thus, to a certain degree, our results imply that they are aware of and consider the potential effects of firms' exposure to more extreme temperatures,

[5]For a comprehensive review of the literature on climate change risks and their effects on financial markets, see Giglio et al. (2021).

which may intensify and become more frequent, as shown by the current studies. For instance, Cuculiza et al. (2024) find that the stocks with higher exposure to abnormal temperature changes earn lower returns. In addition, analysts issue less optimistic forecasts for these overpriced firms. Thus, when firms' exposure to climate change is high, analysts and institutional investors can better understand the influence of climate change on firms' performance (Cuculiza et al., 2021). Pankratz et al. (2023) further document the adverse effects of extremely hot temperatures on a firm's performance, decreasing revenues and operating income. Likewise, according to Addoum et al. (2023), extreme temperatures impact earnings in more than 40% of industries, which are not necessarily limited to agriculture-related firms. Yet, in their 2020 paper, authors find no effect on sales, productivity, and profitability of firms with exposure to temperature nor among the industries, implying no relationship between climate risk and near-term cash flows. Hugon and Law (2019), instead, confirm the negative effects of climate change on firms' earnings at their headquarters. For example, a 1°C increase in temperature leads to an earning' decrease of $1.6 million and a double rise in managers' probability of issuing an optimistic forecast for firms with high exposure and skepticism to climate change. The unusually high temperature also influences retail investors but not institutional, who are likelier to buy and sell stocks with low and high climate sensitivity, respectively (Choi et al., 2020).[6]

Finally, our empirical evidence complements the weather-induced mood literature, informing us about the role of weather in investors' and analysts' decision-making, which, thus, affects financial markets (Jiang et al., 2021; Baylis, 2020; Dehaan et al., 2017; Goetzmann et al., 2015; Schmittmann et al., 2015; Bassi et al., 2013; Hirshleifer and Shumway, 2003; Kamstra et al., 2003). Notably, different from these studies, it highlights that physical climate risk in terms of extreme temperatures matters, especially the effectiveness of both pleasant and unpleasant, hot and cold weather, to the retail investors' return predictability. As such, it explores the weather-related physical impacts instead of the weather-induced mood ones.[7]

[6] As a proxy for the retail investors' trading, Choi et al. (2020) rely on the quarterly equity positions of block holders and institutions and define retail ownership as the difference between 100% and the combined ownership of previous investors. Our paper, instead, looks at the aggregate retail purchases and sales in pleasant and unpleasant firms.

[7] In other words, our definition of unpleasant weather differs from that of literature's weather-mood, which usually focuses on cloudy, rainy, snowy, or windy days as a proxy for an unpleasant mood and, e.g., sunshine for a good mood.

The remainder of the paper is organized as follows. In Section 2, we describe the retail and weather data. Section 3 presents the empirical findings, and Section 4 concludes the paper.

2 Data

To compute the retail investors' activity, we follow the sub-penny price improvement approach of Boehmer et al. (2021), covering the period from January 2010 to December 2018. Specifically, using the TAQ trade data for common stocks with shares codes 10 and 11, we first identify the retail buy and sell trades when prices are just below and above the round penny. We second calculate the order imbalance measure as the difference between the retail buy and sell volume divided by the sum of the retail buy and sell volume. Table 1 reports the summary statistics of these retail measures, e.g., the cross-sectional averages of the time-series statistic (i.e., mean, median, standard deviation, skewness, kurtosis, and percentile values). The negative mean retail order imbalances, e.g., -0.04, indicate that, on average, retail investors buy less than they sell. Their average purchases and sales confirm the above, i.e., the average volume is 38141 and 38207, respectively.

The U.S. weather data, namely, the daily minimum and maximum temperatures, are from the National Oceanic Atmospheric Administration (NOAA) and span from January 2010 to December 2018. Following Addoum et al. (2023) and Schlenker and Roberts (2009), we first compute the degree days above 30°C and below 0°C by fitting a double sine curve that passes through the consecutive daily minimum and maximum temperatures. Table 1 shows that the average unpleasant hot and cold degree days above 30°C and below 0°C are around 0.5°C and 3°C, respectively, confirming the existence of extreme temperatures. As such, we can use these daily measures at the county level to define our pleasant and unpleasant firms by considering their headquarters' location in each county. In particular, we define pleasant firms as those that, during certain days, exhibit pleasant temperatures, i.e., when the degree days above 30°C and below 0°C are zero. Unpleasant hot and cold firms are those when, on various days, the former and later variables are different from zero. Given these definitions, we then create the daily pleasant and unpleasant hot and cold dummy variables at the firm level, which we use over the entire paper. Specifically, the pleasant dummy for each firm is one when the degree days above 30°C and below 0°C are zero and otherwise, is zero. In other words, the pleasant dummy is one when there are no days with unpleasant temperatures,

either above 30°C or below 0°C. The unpleasant hot and unpleasant cold dummies are one when the degree days above 30°C and below 0°C, respectively, exist and zero otherwise.

INSERT TABLE 1 HERE

3 Empirical Findings

This section discusses empirical results by exploring in Section 3.1 whether the retail investors' trading depends on a firm's exposure to weather, i.e., whether their trading significantly varies in pleasant and unpleasant firms. It then explores in Section 3.2 the determinants of retail order imbalances, especially the role of past pleasant and unpleasant imbalances. Next, Section 3.3 investigates the predictive role of retail order imbalances of pleasant and unpleasant firms for future stock returns and earnings surprises. In addition, Section 3.4 decomposes the stock return predictability using retail pleasant and unpleasant imbalances. Section 3.5 further shows whether retail investors' trading in pleasant and unpleasant firms may help construct a profitable trading strategy. Finally, Sections 3.6 and 3.7 study if their pleasant and unpleasant trading leads to return and own order imbalance comovement. Following Boehmer et al. (2021), our analysis, excluding that in Section 3.1, uses overlapping daily frequency data for the weekly order imbalance and return measures.

3.1 *Does retail investors' trading vary depending on a firm's exposure to weather?*

We initiate the empirical findings section by investigating retail investors' trading in firms with various exposures to weather. That is, if there is a significant mean difference in their trading activity, e.g., the order imbalances and buy and sell volume, on and between pleasant and unpleasant firms, namely, those *without* and *with* exposures to extreme hot and cold temperatures. Table 2 documents significantly negative order imbalances implying that retail investors are, on average, net sellers, i.e., sell more than buy, in both pleasant and unpleasant hot and cold firms. It also points out the significant positive mean difference between retail order imbalances of unpleasant firms. These less negative imbalances of unpleasant hot than cold firms indicate that retail investors have less net selling in UH versus UC firms. Looking at the average retail trading volume in pleasant and unpleasant firms, we observe i) that retail buy and sell volumes are significant and ii) a significantly

positive difference in both retail buy and sell volumes between pleasant and both unpleasant hot and cold firms, as well as between the latter. Specifically, retail investors trade around 9% and 32% less in unpleasant hot and cold firms than pleasant ones. They also trade approximately 25% less in unpleasant cold than hot firms.

INSERT TABLE 2 HERE

The above results suggest that retail investors trade depending on a firm's exposure to pleasant and unpleasant temperatures. There is significantly less trading in firms *with* exposures to extreme temperatures, both hot and cold, versus those *without* exposure to such temperatures, i.e., the pleasant firms, which may point towards their preference to trade more on the latter versus former firms. This preference might be due to or reflect their concerns about the potential future effects of extreme temperatures and, thus, climate change risks on firms where they trade.

3.2 *What explains retail investors' order imbalances?*

The previous section shows that retail investors' trading significantly varies between pleasant and unpleasant firms and unpleasant hot and cold ones. Thus, firms' exposures to extreme temperatures matter for retail investors. Given this, Table 3 of this section explores the determinants of retail investors' order imbalances by separately considering retail trading in pleasant and unpleasant hot and cold firms, i.e., past pleasant and unpleasant retail order imbalances. To do so, we use Fama and Macbeth's (1973) two-step estimation where in the first step, for each week, we estimate the following regression:

$$\begin{aligned} Oib(i,w) = & b_0 + b_1 * Oib(i,w-1) * P\,dummy + b_2 * Oib(i,w-1) * UH\,dummy \\ & + b_3 * Oib(i,w-1) * UC\,dummy + b_4' * Controls(i,w-1) + u_0(i,w), \end{aligned} \tag{1}$$

where $Oib(i,w-1) = Oib(i,w-1) * P\,dummy + Oib(i,w-1) * UH\,dummy + Oib(i,w-1) * UC\,dummy$. The daily $P\,dummy$, $UH\,dummy$, and $UC\,dummy$ is one when the degree days above 30°C and below 0°C are zero, degree days above 30°C and below 0°C exist, respectively, and zero, otherwise. Note that as the beginning of this section states, our analysis employs daily overlapping frequency data of a weekly magnitude (see, e.g., Boehmer et al., 2021). Therefore, on

a given day, e.g., $Oib(i, w)$ is the retail order imbalance measure for a firm i at week w, i.e., from day 1 to day 5, and so forth for each of the other days. Similarly, the $Oib(i, w-1)$ is the past order imbalance measure from day -4 to day 0. The interaction coefficients of the $Oib(i, w-1)$ with each of the $P\,dummy$, $UH\,dummy$, and $UC\,dummy$, i.e., b_1, b_2, and b_3, capture the relationship between one-week ahead retail order imbalances and past pleasant and unpleasant order imbalances, i.e., retail activity in pleasant and unpleasant firms. In addition, we account for the past week, month, and six-month returns and several control variables such as the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). In the second step, we take the average of the above daily coefficients and adjust the standard errors using Newey-West (1987) with five lags given Equation (1)'s overlapping daily frequency data.

Table 3 shows the positive relationship between past pleasant and unpleasant order imbalances and the one-week ahead retail imbalances. For instance, the statistically significant b_1, b_2, and b_3 coefficients of 0.1340, 0.1293, and 0.1240 indicate that retail order imbalances of both pleasant and unpleasant firms are persistent. Nevertheless, the most substantial effects belong to past pleasant order imbalances, whereas the least belong to unpleasant cold imbalances. Appendix A.1 confirms these findings by documenting a statistically significant reduction in the effects of past UC order imbalances on future imbalances, e.g., these decrease by 0.0103. The negatively and statistically significant past week, month, and six-month returns coefficients, e.g., -0.6437, -0.2361, -0.0531, underline the contrarian behavior of retail investors, namely, they sell winners and buy losers. Regarding the relationship between control variables and order imbalances, we remark on a positively significant relationship for turnover, volatility, and size and a negative one for B/M.[8]

INSERT TABLE 3 HERE

[8] Appendix A.2 also separately reports the determinants of pleasant and unpleasant order imbalances, i.e., the estimates of a similar regression as in Equation (1) for each subgroup of firms exhibiting pleasant and unpleasant hot and cold weather. In line with our main results, it shows that order imbalances of unpleasant firms are the least persistent, and retail investors are also the most contrarian in these firms. That is, they buy more unpleasant losers and sell more unpleasant winners.

3.3 *Predicting future stock returns and earnings surprises with retail order imbalances of pleasant and unpleasant firms*

Previous sections highlight that retail investors' activity in pleasant and unpleasant firms matters, and their pleasant and unpleasant trades explain future imbalances. As such, this section next examines whether retail order imbalances of pleasant and unpleasant hot and cold firms can predict future stock returns and earnings surprises. Tables 4 and 5 consider their predictive role for future stock returns, whereas Table 6 looks at earnings surprises.

We start by first estimating the role of pleasant and unpleasant imbalances in predicting returns using Fama and Macbeth (1973) regressions as follows:

$$\begin{aligned} Ret(i,w) = {} & c_0 + c_1 * Oib(i,w-1) * P\,dummy + c_2 * Oib(i,w-1) * UH\,dummy \\ & + c_3 * Oib(i,w-1) * UC\,dummy + c_4' * Controls(i,w-1) + u_1(i,w), \end{aligned} \tag{2}$$

$$\begin{aligned} Ret(i,w) = {} & d_0 + d_1 * UH\,dummy + d_2 * Oib(i,w-1) * UH\,dummy \\ & + d_3 * UC\,dummy + d_4 * Oib(i,w-1) * UC\,dummy + d_5 * Oib(i,w-1) \\ & + d_6' * Controls(i,w-1) + u_2(i,w), \end{aligned} \tag{3}$$

where the $P\,dummy$, $UH\,dummy$, and $UC\,dummy$ is one when the degree days above 30°C and below 0°C are zero, degree days above 30°C and below 0°C exist, respectively, and zero, otherwise. $Ret(i,w)$ is the stock returns for a firm i over certain days of week w, e.g., [1, 5] captures the returns from day 1 to day 5, and w weeks ahead. The $Oib(i,w-1)$ is the past order imbalance measure from day -4 to day 0. The interaction coefficients of the $Oib(i,w-1)$ with each of the $P\,dummy$, $UH\,dummy$, and $UC\,dummy$, i.e., c_1, c_2, and c_3, capture the relationship between past pleasant and unpleasant order imbalances, i.e., retail activity in pleasant and unpleasant firms, and future stock returns. We also include the control variables from Equation (1).

Examining Table 4, we find a significantly positive relationship between the past week's order imbalances of pleasant and unpleasant hot and cold firms and future returns. In addition, we remark that the predictive power of pleasant and unpleasant order imbalances differs and depends on the short and long-run future returns. For instance, the pleasant and unpleasant imbalances'

effects on the one-week ahead return, i.e., the c_1, c_2, and c_3 coefficients, are around 0.10% versus 0.07% and 0.05%, respectively. The higher c_1 coefficient than the c_2 and c_3 coefficients underlines that the average impacts of pleasant order imbalances on future returns are substantially larger than those of unpleasant imbalances. The results generally hold at both short and long-run predictive return horizons. We further show that while pleasant order imbalances positively predict returns up to ten weeks ahead, unpleasant hot and cold imbalances only predict them up to four and two weeks ahead. Also, unpleasant order imbalances' predictive power is stronger for these horizons than pleasant imbalances.

INSERT TABLE 4 HERE

Table 5 reinforces Table 4's conclusion, pointing to an average lower influence from retail order imbalances of unpleasant firms on short-run returns and higher on the long-run returns. In particular, the negatively and typically statistically significant coefficients of the $Oib(i, w-1)$*$UC\,dummy$, i.e., d_4, from Equation (3) indicate that unpleasant cold order imbalances attenuate their average positive predictability on short-run returns. Hence, their average effects on returns are lower, as Table 4 reports. Instead, these imbalances strengthen the positive relationship for the two weeks ahead returns (see, e.g., the positive significant d_4 coefficient of 0.04%) and, thus, lead to stronger average return predictability, as Table 4 shows. Regarding the unpleasant hot order imbalances' effects on returns, we observe that the d_2 coefficient of $Oib(i, w-1)$*$UH\,dummy$ is usually negative but not statistically significant. However, it is positively and statistically significant for the four weeks ahead returns, i.e., 0.05%, suggesting an enhancement in the positive predictability of unpleasant hot imbalances. Hence, it consolidates Table 4's finding on the average predictive power of unpleasant imbalances being the strongest for this return horizon.

Considering the influence of past returns, both Tables 4 and 5 report negative and statistically significant coefficients on the past week's returns for the short-run future returns, i.e., up to one week ahead. Instead, the past month and six-month return coefficients are not statistically significant, indicating that significant reversals occur only in the short term. The other control variables are usually insignificant. However, we observe a significant negative turnover and size for certain future returns (e.g., from [1, 4] to four weeks ahead and six to twelve weeks ahead for the former and

latter variables, respectively).[9]

INSERT TABLE 5 HERE

The above findings confirm that, on average, retail investors' trading in both pleasant and unpleasant firms is in the right direction, i.e., higher buying than selling in a given week leads to significantly higher future stock returns. Thus, they are informed. However, retail trading in unpleasant cold and hot firms weakens and strengthens the positive predictability for certain future returns and, hence, the overall predictability of retail imbalances.

Second, we look at the role of pleasant and unpleasant imbalances in predicting earnings surprises which we proxy by the sign of analysts' earnings forecast errors, namely, the difference between actual earnings-per-share and the median I/B/E/S analyst forecast. To do so, we estimate the following Fama and Macbeth (1973) regression:

$$\begin{aligned} FE(i,[t+x,t+y]) = {} & e_0 + e_1 * Oib(i,[0]) * P\,dummy + e_2 * Oib(i,[0]) * UH\,dummy \\ & + e_3 * Oib(i,[0]) * UC\,dummy + e_4 * Ret(i,[0]) + e_5 * Ret(i,[-5,-1]) \\ & + e_6 * Ret(i,[-26,-6]) + e_7' * Controls(i,w-1) + u_3(i,[t+x,t+y]), \end{aligned} \tag{4}$$

where the $P\,dummy$, $UH\,dummy$, and $UC\,dummy$ variables are the same as in previous equations, and $FE(i,[t+x,t+y])$ is the forecast error dummy equal to one when the earnings forecast errors over days $t+x$ and $t+y$ are positive and zero if there is a negative surprise for a firm i. The independent variables consist of the $Oib(i,[0])$ and $Ret(i,[0])$, i.e., the daily order imbalance measure and returns of firm i for day 0. Additionally, we control for the past week ($Ret(i,[-5,-1])$) and month $Ret(i,[-26,-6])$ returns and the past month's size and logarithm of the book-to-market. Following Kelley and Tetlock (2013), we include at least fifty earnings announcements for each daily logistic regression.

[9] Appendix A.3 also separately reports the return predictability of pleasant and unpleasant order imbalances, i.e., the estimates of a similar regression as in Equation (2) for each subgroup of firms exhibiting pleasant and unpleasant hot and cold weather. Similar to Tables 4 and 5, it documents a significantly positive relationship between past order imbalances of pleasant and unpleasant firms and their one-week-ahead returns, with the unpleasant cold firms displaying the least strong relationship. In addition to the negatively significant coefficients of the past week's returns for both pleasant and unpleasant firms, the past month's coefficients are also statistically significant for pleasant and unpleasant cold firms, indicating the existence of reversals.

Table 6 shows that both pleasant and unpleasant order imbalances positively and significantly predict the short-run earnings surprises, e.g., during days [1, 2], [1, 3], and [1, 5]. The predictability of the former imbalances also holds in the long-run. Still, retail order imbalances of unpleasant hot and pleasant firms convey the most substantial effects. For instance, a bottom-to-top decile change in imbalances of P, UH, and UC firms yields a change of around 46% ($e^{0.1560(0.685-(-0.735))-1}$), 49% and 42%, respectively, in the odds ratio for a positive one week ahead earnings surprise.

INSERT TABLE 6 HERE

In sum, our previous results highlight that return predictability varies with i) the pleasant and unpleasant hot and cold imbalances and ii) the short and long-run horizons. Retail order imbalances of pleasant and unpleasant firms also correctly and significantly predict earnings surprises in the short run.

3.4 *Decomposition of stock return predictability using retail order imbalances of pleasant and unpleasant firms*

The previous section shows the significant influence of retail investors' trades in pleasant and unpleasant firms on future returns. Moreover, the study by Boehmer et al. (2021) proposes a new method, namely, the two-stage decomposition, to explain the order imbalances' predictive power for future returns by distinguishing between three alternative hypotheses. These are the order imbalances' persistence, i.e., price pressure (Chordia and Subrahmanyam, 2004), contrarian (Kaniel et al., 2008), and the other information hypothesis (Kelley and Tetlock, 2013). Given our empirical evidence, in this section, we adapt this decomposition approach to our setting and decompose the stock return predictability using pleasant and unpleasant retail order imbalances. That is, we distinguish between the order imbalances' persistence of pleasant and unpleasant hot and cold firms besides accounting for the latter two hypotheses. In particular, we decompose order imbalances into five components, i.e., pleasant persistence, unpleasant hot persistence, unpleasant cold persistence, contrarian relates to the past returns over different horizons, and other imbalances. These reflect the price pressure in pleasant and unpleasant firms, the liquidity provision hypothesis, and the private information of future returns.

To decompose the past weeks' order imbalances, i.e., $Oib(i, w-1)$, we use Fama and Macbeth's (1973) two-step estimation where in the first step for each week, we estimate the following regression:

$$\begin{aligned} Oib(i,w-1) = f_0 + f_1 * Oib(i,w-2) * P\,dummy + f_2 * Oib(i,w-2) * UH\,dummy \\ + f_3 * Oib(i,w-2) * UC\,dummy + f_4' * Ret(i,w-2) + u_4(i,w-1). \end{aligned} \tag{5}$$

We then use Equation's (5) time series of coefficients, i.e., $\widehat{f_0}$, $\widehat{f_1}$, $\widehat{f_2}$, $\widehat{f_3}$, and $\widehat{f_4'}$, to compute the five components of $Oib(i, w-1)$ as follows:

$$\begin{aligned} \widehat{Oib}_{i,w-1}^{P\,persistance} &= \widehat{f_1} * Oib(i,w-2) * P\,dummy, \\ \widehat{Oib}_{i,w-1}^{UH\,persistance} &= \widehat{f_2} * Oib(i,w-2) * UH\,dummy, \\ \widehat{Oib}_{i,w-1}^{UC\,persistance} &= \widehat{f_3} * Oib(i,w-2) * UC\,dummy, \\ \widehat{Oib}_{i,w-1}^{contrarian} &= \widehat{f_4'} * Ret(i,w-2), \\ \widehat{Oib}_{i,w-1}^{other} &= \widehat{u_4} + \widehat{f_0}, \end{aligned} \tag{6}$$

where $\widehat{Oib}_{i,w-1}^{persistance} = \widehat{Oib}_{i,w-1}^{P\,persistance} + \widehat{Oib}_{i,w-1}^{UH\,persistance} + \widehat{Oib}_{i,w-1}^{UC\,persistance}$. Therefore, given Equations (5) and (6), we can calculate the past weeks' order imbalances by adding the above five components as follows:

$$Oib(i,w-1) = \widehat{Oib}_{i,w-1}^{P\,persistance} + \widehat{Oib}_{i,w-1}^{UH\,persistance} + \widehat{Oib}_{i,w-1}^{UC\,persistance} + \widehat{Oib}_{i,w-1}^{contrarian} + \widehat{Oib}_{i,w-1}^{other}. \tag{7}$$

In the second step, we estimate the future return predictability by considering the above five components in a similar regression as in Equation (2) as follows:

$$\begin{aligned} Ret(i,w) = g_0 + g_1 * \widehat{Oib}_{i,w-1}^{P\,persistance} + g_2 * \widehat{Oib}_{i,w-1}^{UH\,persistance} + g_3 * \widehat{Oib}_{i,w-1}^{UC\,persistance} \\ + g_4 * \widehat{Oib}_{i,w-1}^{contrarian} + g_5 * \widehat{Oib}_{i,w-1}^{other} + g_6' * Controls(i,w-1) + u_5(i,w), \end{aligned} \tag{8}$$

where g_1, g_2, and g_3 coefficients reflect the contribution of the three persistence components of $Oib(i, w-1)$, namely, pleasant persistence, $\widehat{Oib}_{i,w-1}^{P\,persistance}$, unpleasant hot persistence, $\widehat{Oib}_{i,w-1}^{UH\,persistance}$, and unpleasant cold persistence, $\widehat{Oib}_{i,w-1}^{UC\,persistance}$, respectively, to future returns. The g_4 and g_5 coefficients capture the contribution of last two components of $Oib(i, w-1)$ to returns, namely, the

contrarian patterns, $\widehat{Oib}_{i,w-1}^{contrarian}$ and residual, $\widehat{Oib}_{i,w-1}^{other}$.

Table 7 reports the decomposition results from Equations (5) and (8) in Panels A and B, respectively. In line with Table 3, Panel A points out the significantly positive relationship between the past week's pleasant and unpleasant and future retail order imbalances. It also confirms retail investors' contrarian trading, e.g., the past week, month, and six-month return coefficients are significantly negative, i.e., -0.4240, -0.2104, and -0.0467, respectively. Panel B then reports the individual contribution of pleasant and unpleasant persistence and contrarian and other information from Equation (6) to the one-week ahead return predictability. We observe that the coefficient of pleasant persistence, 0.0045, is statistically significant, whereas that of unpleasant hot and cold persistence is insignificantly positive and negative, i.e., 0.0179 and -0.0044. These results indicate that the price pressure of pleasant firms significantly and positively contributes to the pleasant retail order imbalances' predictive power. Instead, with respect to the pressure of unpleasant firms, we cannot reject the null hypothesis that it does not contribute to their respective order imbalances' predictability. Likewise, the insignificant contrarian coefficient implies that we cannot reject the null hypothesis that the contrarian patterns do not add to the predictive ability of order imbalances. The last coefficient from the order imbalances' decomposition of 0.0008 is statistically significant, indicating the other information's relevance.[10]

INSERT TABLE 7 HERE

3.5 *Can we use retail investors' trading in pleasant and unpleasant firms as a signal to create a profitable trading strategy?*

In this section, we investigate if retail investors' trading in pleasant and unpleasant firms may help construct profitable trading strategies. In particular, do retail investors correctly select pleasant and unpleasant firms to buy and sell? If not, is there a significant difference in their choices regarding the purchases and sales of pleasant and unpleasant hot and cold firms? What about their trading ability in unpleasant hot and unpleasant cold firms? To explore these questions, we sort firms into quintiles each day using the previous week's retail order imbalance measure. Then, for each

[10] Considering the retail return decomposition separately for each subgroup of firms, namely, pleasant and unpleasant hot and cold, Appendix A.4 displays similar results.

quintile, we select those firms exhibiting pleasant, unpleasant hot, and unpleasant cold weather, holding them from one to twelve weeks. Table 8 reports the average value-weighted portfolio returns relying on the previous month's market capitalization for each quintile and those of two long−short strategies, namely, Q5−Q1 and Q4−Q1, in Panel A and average order imbalances across quintiles in Panel B. These consist of buying stocks of the pleasant and unpleasant firms in the top highest order imbalance quintiles, i.e., Q5 and Q4, and selling the pleasant and unpleasant stocks in the lowest order imbalance quintile, Q1. If retail investors trade in the right direction, then the returns of both pleasant and unpleasant firms should be larger when their order imbalances are high, i.e., for Q5 and Q4, than when these are low, Q1. For each quintile and long−short strategy, Table 8 also reports the difference in average portfolio returns between i) pleasant and unpleasant hot firms (P−UH), ii) pleasant and unpleasant cold firms (P−UC), and iii) unpleasant hot and unpleasant cold firms (UH−UC). If retail investors' trading varies depending on a firm's exposure to weather, then we would expect a significant difference in these average portfolio returns between pleasant and unpleasant firms and between unpleasant ones.

Exploring Table 8, we usually note an increase in returns of pleasant and unpleasant hot firms from Q1 to Q5. These significant patterns convey that retail net buyers of these firms exhibit higher returns than net sellers. Indeed, over a one-week horizon, remark the positively significant pleasant and unpleasant hot Q5−Q1 portfolio return of 0.11% and 0.18%. Their significance holds across all horizons, namely, up to over twelve weeks ahead, when the average P and UH return reaches 0.67% and 0.87%, respectively. Instead, unpleasant cold firms' returns significantly rise until Q4 and then drop in Q5.[11] For instance, the portfolio return of UC firms with the highest retail order imbalances, Q5, is lower than that of Q4 and Q3, e.g., 0.24% versus 0.46% and 0.38%. Additionally, it is comparable to the around 0.23% portfolio return of the lower retail order imbalances in Q1 and Q2, i.e., when retail investors are net sellers. The statistically insignificant Q5−Q1 portfolio return, although usually positive up to the 12-week horizon, also consolidates our above results. As such, this decline in the UC return holding across our horizons suggests that by being net sellers and buyers in unpleasant cold firms, retail investors do not experience similar benefits as they would

[11] The portfolio return of UH firms is also similar in Q4 and Q3, and over various week horizons, it is even slightly lower in the former than in the latter quintile. Appendix A.5 also reports similar patterns for the alphas of UC firms. However, in contrast to the UC portfolio return, the highest order imbalance quintile, Q5, displays the highest return.

by trading in pleasant and unpleasant hot firms. The low Q5 portfolio return is possibly due to trading in the wrong direction, especially regarding their inability to choose the UC firms to buy correctly. This finding aligns with that of Table's 5, which shows that retail investors' trades in UC firms reduce the positive return predictability of order imbalances. It also makes sense, given that the UC portfolio return is significantly higher when average retail order imbalances are lower in Q4 versus Q5, e.g., 0.36 versus 1.31. Moreover, the Q4−Q1 portfolio return is significantly positive from one up to four weeks ahead, e.g., around 0.21%, 0.33%, and 0.35% for the 1, 2, and 4-week horizon, respectively. These results imply that retail investors trade the UC firms in the right direction but only in the short-run and when, although they are not necessarily net buyers, they still buy more than they sell.

Next, we examine whether a significant return difference exists between retail trading activity in pleasant and unpleasant firms and between their long−short strategies. First, the difference between pleasant and unpleasant hot portfolio return P−UH is significantly positive from one and six to 12-week horizon for Q4 and Q3, respectively. This positive difference, e.g., for Q4 of around 0.8%, 0.13%, 0.29%, 0.42%, 0.57%, 0.66%, and 0.57% across the holding horizon to 1, 2, 4, 6, 8, 10, and 12 weeks indicate that retail investors achieve a better performance when buying and selling P than UH stocks, i.e., those of firms exposed to pleasant rather than unpleasant hot weather. In particular, when they are neither net sellers nor buyers, i.e., their average P imbalances are approximately −0.10 and 0.35 (see the Q3 and Q4). Moreover, the average return of the long−short portfolio of the P firms is significantly higher than that of UH firms, confirming the above for Q4−Q1 in the long run, i.e., for the 8, 10, and 12-week horizon when it is 0.42%, 0.46%, and 0.47%, respectively.

Second, comparing the pleasant and unpleasant cold portfolio returns across quintiles, note that the latter's average return is significantly higher, especially for Q4 and Q3. For instance, over the one- and two-week horizon, the average return difference P−UC is statistically significant around −0.14%, and −0.24% for Q4, whereas, for Q3, it is negatively significant over two to six weeks ahead. These findings suggest that retail investors may be better off trading in UC firms, at least over a holding horizon of up to two or six weeks, only when they either buy more than sell but are not net sellers (Q4) or sell slightly more than buy (Q3), respectively. Instead, when retail investors are net buyers in P and UC firms, i.e., Q5, the average return of the former portfolio is significantly

greater than the latter portfolio, e.g., the mean difference P−UC is 0.12% and 0.15% over the one- and two-week horizon. The substantially significant performance of the long−short portfolio of UC than P firms over a holding horizon of up to two weeks reconfirms the previous inference, highlighting that retail investors better choose the stocks of UC firms to buy and sell than those of P firms. For example, the average return difference between these trading strategies, Q4−Q1, is approximately −0.17% and −0.32%.

Third, looking at the return difference between unpleasant hot and cold portfolios, UH−UC across quintiles, we find that over the 12-week horizon, it is significantly negative for both Q4 and Q3. In other words, it suggests that when retail investors either buy marginally more than sell or sell marginally more than buy but are neither net buyers nor sellers, trading in UC firms provides them substantially higher returns than in UH firms. Nevertheless, the significantly superior performance of the UC long−short trading strategy to that of the UH long−short strategy only holds over a one- and two-week horizon. For instance, the Q4−Q1 return difference between these strategies is −0.21% and −0.41%, respectively.

INSERT TABLE 8 HERE

Overall, our findings emphasize i) that P and UH firms with higher order imbalances outperform those with lower imbalances (see, e.g., Q5−Q1) and ii) the insignificant Q5−Q1 portfolio return of UC firms but the positively significant return for the Q4−Q1 strategy. This evidence suggests that retail investors trade in the right direction, P and UH firms, but cannot correctly choose UC firms to buy such that the Q5 portfolio return is higher than that of Q1. Nevertheless, when they buy marginally more than sell UC firms, the Q4−Q1 trading strategy provides an even better return than those strategies of P and UH firms. Specifically, results show that i) in the shorter run, the performance of the UC trading strategy is significantly higher than that of the P and UH (w=1-2), and ii) in long-run, the performance of the P trading strategy is significantly larger than that of the UH (w=8-12).[12]

[12]Appendix A.5 reports akin results on the alphas of these P, UH, and UC portfolios across quintiles and the long−short trading strategies.

3.6 *Can retail investors' trading in pleasant and unpleasant firms induce return comovement?*

The previous section documents the significant performance of pleasant and unpleasant portfolio returns across retail order imbalance quintiles and the significant return difference between their trading strategies. As such, this section further examines whether retail trading in pleasant and unpleasant firms induces a comovement in their returns. Specifically, Tables 9 and 10 present the return comovement inferences of the rolling regression models from Equations (9) and (10) using a forward-looking 30-day window[13] for each of the low and high retail order imbalance portfolio return as well as the pleasant and unpleasant low and high portfolio returns as follows:

$$Ret(i,t) = h_0 + h_1 * Pf(t) + h_2' * Controls(t) + u_6(i,t), \tag{9}$$

$$Ret(i,t) = m_0 + m_1 * Pf^{P/UH/UC}(t) + m_2' * Controls(t) + u_7(i,t), \tag{10}$$

where $Ret(i,t)$ is the firm's i returns on the day t, Pf is the low and high portfolio return, and $Pf^{P/UH/UC}$ captures each of the low and high portfolio returns of pleasant and unpleasant hot and cold firms. We also include Fama and French's (1993) three factors as control variables (Goetzmann et al., 2015).

Using the time series coefficients $\widehat{h_1}$ capturing each low and high order imbalance return comovement, we select the firms exposed to P, UH, and UC weather. Panels A and B of Table 9 report the value- and equal-weighted average comovement coefficients and their difference between i) pleasant and unpleasant firms and ii) high and low return portfolios. We document a significant difference in return comovement between P, UH, and UC firms with low and high return portfolios, e.g., the P−UH, P−UC, and UH−UC coefficients are negatively significant. These findings indicate that regardless of whether retail investors are net buyers or sellers, unpleasant firms' returns comove more than pleasant ones, and the return comovement of UC firms is higher than that of UH firms. Additionally, we find that returns of pleasant and unpleasant firms comove less (more) with the high (low) return portfolios, respectively, e.g., the high−low value-weighted average comovement

[13] As robustness, Appendices A.6 and A.7 provide consistent results using a 90-day window.

coefficients of P, UH, and UC firms are negatively significant, −0.056, −0.055, and −0.050. Thus, pleasant and unpleasant firms exhibit a significantly weaker comovement with the return portfolio of firms where retail investors are net buyers rather than net sellers.

INSERT TABLE 9 HERE

Similarly, we also sort firms into P, UH, and UC, using the $\widehat{m_1}$ coefficients capturing the low and high order imbalance comovement of pleasant and unpleasant hot and cold firms. By doing so, we explore whether retail trading in pleasant and unpleasant firms induces a return comovement in their returns. Panels A and B of Table 10 report the value- and equal-weighted average pleasant and unpleasant comovement coefficients and their difference between i) pleasant and unpleasant firms and ii) high and low return portfolios. Investigating the return comovement with pleasant and unpleasant low and high return portfolios, in line with Table 9, unpleasant firms comove significantly more than pleasant firms, e.g., the P−UH, P−UC, and UH−UC coefficients are substantially negative. Likewise, the negative and significant high−low coefficients indicate that return comovement is weaker with the high than low return portfolio. Nevertheless, examining their magnitude, note that the high−low coefficients of pleasant firms are less negative for the P portfolio, which underlines their lower comovement than of UH and UC firms with the return portfolio of pleasant firms where retail investors are net buyers. Also, as we expect, the return comovement degree of UH and UC firms is higher with the UH and UC portfolio, respectively, yet the negative high−low coefficients indicate that firms comove substantially less when retail investors are net buyers than sellers.

INSERT TABLE 10 HERE

3.7 *Can retail investors' trading in pleasant and unpleasant firms lead to own order imbalance comovement?*

This section examines if retail trading in pleasant and unpleasant firms induces a comovement in order imbalances. Similar to previous Section 3.6, we estimate the order imbalance comovement

using rolling regressions with a forward-looking 30-day window as follows:[14]

$$Oib(i,w) = p_0 + p_1 * Pf_{oib}(w) + u_8(i,w), \tag{11}$$

$$Oib(i,w) = s_0 + s_1 * Pf_{oib}^{P/UH/UC}(w) + u_9(i,w), \tag{12}$$

where $Oib(i,w)$ is the firm's i order imbalances, Pf_{oib} is the low and high order imbalance portfolio, and $Pf_{oib}^{P/UH/UC}$ captures each of the low and high order imbalance portfolios of pleasant and unpleasant hot and cold firms. Akin to the previous section, we sort firms into P, UH, and UC, relying on the time series coefficients $\widehat{p_1}$ and $\widehat{s_1}$. The former coefficients inform about the order imbalance comovement of pleasant and unpleasant firms with the low and high order imbalance portfolios, i.e., those consisting of firms where retail investors are net sellers and buyers. The latter ones capture the comovement of pleasant and unpleasant with the pleasant and unpleasant low and high order imbalance portfolios, i.e., those of pleasant and unpleasant firms where retail investors are net sellers and buyers.

In general, Table 11 shows a larger comovement in retail imbalances of unpleasant than pleasant firms. Nevertheless, although the comovement difference between these firms is negative, i.e., P−UH, P−UC, and UH−UC, usually only that between P and UC firms is statistically significant. Using a 90-day window to estimate Equation (11), Appendix A.8 also reports a negatively significant comovement difference between UH and UC firms. The negatively significant high−low imbalance comovement of P firms suggests that these firms comove significantly less with the high than low imbalance portfolio, i.e., with firms where retail investors are net buyers than sellers. Instead, retail imbalances' of unpleasant firms comove closely with low and high imbalance portfolios.

INSERT TABLE 11 HERE

Table 12 documents higher order imbalance comovement of UC firms than of P and UH firms, e.g., P−UC and UH−UC coefficients are negatively significant, with low and high imbalance portfolios of pleasant and unpleasant firms. Examining the high−low imbalance comovement of pleasant and unpleasant firms, we generally find no significant differences, suggesting that pleasant and

[14]The average results in Appendices A.8 and A.9 are generally robust when using a 90-day window.

unpleasant firms' imbalances comove similarly with P, UH, and UC firms regardless of whether retail investors are net buyers or sellers in them. However, as an exception, we note that P firms' imbalances comove significantly less with P firms where retail investors are net buyers, i.e., the high imbalance portfolio.

INSERT TABLE 12 HERE

4 Conclusion

This paper assesses retail investors' activity on pleasant and unpleasant firms, i.e., whether their trading depends on a firm's exposure to extreme weather as a proxy for physical climate risk. It applies Boehmer et al.'s (2021) sub-penny approach to identify retail trades and defines pleasant and unpleasant firms as those *without* and *with* exposure to extreme temperatures, e.g., hot and cold.

Empirical findings highlight that retail investors trade substantially less in unpleasant firms, i.e., UH and UC, than pleasant firms. This evidence may reflect the recognition of the possible future effects of such extreme events on firms in which they trade. The retail imbalances of UH and UC firms are also less persistent and positively predict future returns up to four and two weeks ahead. In contrast, the imbalances' predictability of P firms holds up to ten weeks ahead, yet its predictive power is less strong than that of unpleasant firms for the four and two weeks ahead returns. We consolidate these inferences by showing that the incremental return predictability of UC firms' imbalances usually weakens in the short run, i.e., up to one week ahead, while that of both UH and UC firms' imbalances strengthens for the four and two weeks ahead, respectively. The past retail order imbalances of pleasant and unpleasant firms also positively predict earnings surprises in the short run, whereas those of the former also hold in the long run.

By further decomposing return predictability using retail order imbalances of pleasant and unpleasant firms, we emphasize the relevance of P firms' price pressure, which positively contributes to the P retail order imbalances' predictive power and future returns' private information. Furthermore, we uncover that while in the short run, the performance of a UC trading strategy dominates those of P and UH strategies, in the long run, the P strategy outperforms. Hence, retail investors' trading

in pleasant and unpleasant firms may provide valuable signals for trading strategies. Finally, return and order imbalance comovement generally varies depending on pleasant and unpleasant firms and retail investor activity in these firms. At the return level, unpleasant firms comove more than pleasant ones, and when retail investors are net buyers and sellers, both pleasant and unpleasant firms comove less and more, respectively. Regarding retail imbalances, the UC firms comove more, and retail net purchases led to less comovement in P and UC firms.

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Table 1: Summary Statistics

							Percentile		
	Mean	Median	StdDev	Skewness	Kurtosis	5th	25th	75th	95th
Order imbalances	−0.04	−0.05	0.47	0.01	2.64	−0.74	−0.42	0.35	0.69
Buy volume	38141	22901	60797	8.65	142	6974	13445	41169	112619
Sell volume	38207	23668	59009	8.93	148	7722	14246	41393	110069
Unpleasant **hot**	0.47	0.30	0.52	1.91	8.18	0.002	0.07	0.70	1.48
cold	2.72	2.15	2.34	1.26	4.90	0.19	0.92	3.87	7.48

Note: This table presents summary statistics of retail order imbalances, buy and sell volume, and degree days above 30°C and below 0°C as proxies for the unpleasant hot and cold weather. Specifically, we take the time-series statistic (i.e., mean, median, standard deviation, skewness, kurtosis, and percentile values) for each retail measure and firm and then report the cross-sectional mean of it. The sample period is January 2010 to December 2018. We compute the retail measures using the sub-penny price improvement approach of Boehmer et al. (2021) and the degree days variables following Addoum et al. (2023) and Schlenker and Roberts (2009). We calculate the order imbalance measure by dividing the difference between the retail buy and sell volume to the sum of the retail buy and sell volume.

Table 2: Retail Investors' Activity on Pleasant and Unpleasant Firms

	P	UH	UC	P – UH	P – UC	UH – UC
Order imbalances	−0.0264	−0.0229	−0.0321	−0.0035	0.0056	0.0092
	−22.59	−7.31	−7.79	−1.20	1.43	1.90
Buy volume	47570	44033	32487	3537	15163	11526
	64.38	41.98	25.02	3.05	12.22	7.03
Sell volume	47288	43138	32577	4150	14783	10531
	67.06	51.55	25.59	4.30	12.43	7.02

Note: This table presents the retail investors' activity in pleasant (P), unpleasant hot (UH), and cold (UC) firms. Specifically, it reports the time-series averages of the cross-sectional mean and their difference for retail measures of pleasant and unpleasant firms. The sample period is January 2010 to December 2018. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero.

Table 3: Determinants of Retail Order Imbalances

Constant	−0.3700
	−12.87
Order imbalances (w−1) * P dummy	0.1340
	35.32
Order imbalances (w−1) * UH dummy	0.1293
	21.64
Order imbalances (w−1) * UC dummy	0.1240
	21.55
Returns (w−1)	−0.6437
	−19.73
Returns (m−1)	−0.2361
	−13.23
Returns (m−7, m−2)	−0.0531
	−8.45
Turnover	0.0132
	2.16
Volatility	0.2565
	2.14
Size	0.01220
	9.09
B/M	−0.01515
	−8.80
Adj. R^2	2.55%

Note: This table presents the retail investors' trading activity determinants, considering the past imbalances of pleasant (P) and unpleasant hot (UH) and cold (UC) firms. The sample period is January 2010 to December 2018. We estimate Equation (1) using the Fama-MacBeth procedure, considering retail order imbalances of firms exhibiting pleasant and unpleasant hot and cold weather. The $P\,dummy$, $UH\,dummy$, and $UC\,dummy$ is one when the degree days above 30°C and below 0°C are zero, degree days above 30°C and below 0°C exist, respectively, and zero, otherwise. The dependent variable is the one-week ahead retail order imbalance measure. The independent variables consist of the past week's pleasant and unpleasant order imbalances and returns and the past one and six-month returns. As control variables, we include the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 4: Return Predictability of Retail Pleasant and Unpleasant Firms

	[1]	[1, 2]	[1, 3]	[1, 4]	[1, 5]	w=2	w=4	w=6	w=8	w=10	w=12
Constant	0.0004	0.0006	0.0012	0.0022	0.0035	0.0015	0.0056	0.0092	0.0081	0.0081	0.0071
	0.57	0.40	0.64	0.91	1.22	0.55	2.01	3.00	2.80	2.65	2.45
Order imbalances (w−1) * P dummy	0.0003	0.0005	0.0007	0.0009	0.0010	0.0005	0.0003	0.0002	0.0001	0.0002	0.0000
	9.04	10.17	10.76	10.81	10.96	5.68	3.69	2.18	0.57	1.87	0.32
Order imbalances (w−1) * UH dummy	0.0003	0.0005	0.0007	0.0008	0.0007	0.0008	0.0008	−0.0003	0.0001	−0.0002	−0.0001
	3.07	3.01	3.33	3.28	2.52	2.69	2.77	−1.02	0.22	−0.56	−0.37
Order imbalances (w−1) * UC dummy	0.0002	0.0003	0.0004	0.0005	0.0005	0.0009	−0.0001	0.0001	−0.0001	0.0001	0.0003
	1.62	2.33	2.01	2.13	2.21	3.89	−0.36	0.31	−0.42	0.51	0.87
Returns (w−1)	−0.0159	−0.0225	−0.0274	−0.0319	−0.0354	−0.0043	−0.0022	−0.0033	0.0034	−0.0028	−0.0003
	−9.74	−10.04	−9.53	−9.31	−9.44	−1.19	−0.68	−1.19	1.09	−1.08	−0.11
Returns (m−1)	−0.0008	−0.0012	−0.0015	−0.0015	−0.0017	−0.0009	0.0002	0.0013	−0.0014	0.0003	0.0007
	−1.14	−0.99	−0.85	−0.70	−0.69	−0.42	0.09	0.60	−0.72	0.16	0.30
Returns (m−7, m−2)	−0.0002	−0.0005	−0.0006	−0.0010	−0.0013	−0.0002	0.0002	0.0000	0.0002	0.0005	0.0001
	−0.96	−1.22	−1.01	−1.35	−1.46	−0.26	0.27	0.03	0.25	0.52	0.13
Turnover	−0.0003	−0.0009	−0.0012	−0.0018	−0.0020	−0.0026	−0.0020	−0.0006	−0.0012	−0.0023	−0.0032
	−1.00	−1.56	−1.58	−1.83	−1.78	−2.80	−2.08	−0.68	−1.25	−2.33	−3.09
Volatility	0.0017	0.0052	0.0023	0.0009	−0.0025	0.0056	−0.0131	−0.0161	0.0108	0.0239	0.0386
	0.31	0.51	0.17	0.05	−0.13	0.29	−0.76	−0.85	0.55	1.23	2.04
Size	0.00001	0.00004	0.0000	0.0000	0.00000	0.00010	−0.0001	−0.0003	−0.0003	−0.0003	−0.0003
	0.24	0.56	0.40	0.26	0.02	0.73	−0.72	−1.93	−1.83	−2.02	−1.97
B/M	0.00004	0.00011	0.0001	0.0002	0.00032	0.0004	0.00044	0.0002	0.0001	0.0002	0.0001
	0.53	0.82	0.71	0.90	1.12	1.52	1.56	0.81	0.39	0.58	0.38
Adj. R^2	3.53%	3.75%	3.79%	3.80%	3.74%	3.42%	2.90%	2.80%	2.85%	2.90%	2.87%

Note: This table presents the return predictability of the retail order imbalances of pleasant (P), unpleasant hot (UH), and cold (UC) firms. The sample period is January 2010 to December 2018. We estimate Equation (2) using the Fama-MacBeth procedure, considering retail order imbalances of firms exhibiting pleasant and unpleasant hot and cold weather. The *P dummy*, *UH dummy*, and *UC dummy* is one when the degree days above 30°C and below 0°C are zero, degree days above 30°C and below 0°C exist, respectively, and zero, otherwise. The dependent variables include the short-run and w-weeks ahead returns. The independent variables consist of the past week's pleasant and unpleasant order imbalances and returns and the past one and six-month returns. As control variables, we include the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 5: Return Predictability and the Effects of Retail Pleasant and Unpleasant Firms

	[1]	[1, 2]	[1, 3]	[1, 4]	[1, 5]	w=2	w=4	w=6	w=8	w=10	w=12
Constant	0.0005	0.0006	0.0013	0.0022	0.0036	0.0017	0.0056	0.0091	0.0081	0.0081	0.0072
	0.62	0.45	0.67	0.92	1.26	0.60	2.00	2.98	2.79	2.64	2.46
UH dummy	0.0000	−0.0001	−0.0001	−0.0001	−0.0003	−0.0002	0.0007	0.0009	0.0006	0.0002	0.0000
	0.31	−0.32	−0.37	−0.44	−0.75	−0.55	2.11	2.59	1.91	0.63	0.05
Order imbalances (w−1) * UH dummy	0.00005	−0.0001	−0.00001	−0.0001	−0.0003	0.0003	0.0005	−0.0004	0.0001	−0.0003	−0.0001
	0.43	−0.34	−0.03	−0.42	−1.15	0.75	1.78	−1.48	0.44	−1.02	−0.35
UC dummy	−0.0001	−0.0001	−0.00002	−0.0001	−0.0003	0.0002	0.0001	0.00005	−0.0001	−0.0001	0.0003
	−0.58	−0.35	−0.07	−0.22	−0.85	0.53	0.26	0.14	−0.20	−0.38	0.93
Order imbalances (w−1) * UC dummy	−0.0001	−0.0002	−0.0004	−0.0005	−0.0006	0.0004	−0.0005	−0.0002	−0.0002	−0.0001	0.0003
	−1.16	−1.55	−2.05	−2.04	−2.24	1.74	−1.44	−0.56	−0.74	−0.39	0.95
Order imbalances (w−1)	0.0003	0.0005	0.0007	0.0009	0.0010	0.0005	0.0004	0.0002	0.0000	0.0002	0.0000
	8.95	9.94	10.50	10.61	10.85	5.85	3.82	2.06	0.41	1.76	0.25
Returns (w−1)	−0.0159	−0.0226	−0.0275	−0.0320	−0.0355	−0.0042	−0.0021	−0.0034	0.0033	−0.0028	−0.0003
	−9.79	−10.11	−9.61	−9.39	−9.51	−1.18	−0.66	−1.20	1.08	−1.09	−0.10
Returns (m−1)	−0.0008	−0.0012	−0.0015	−0.0015	−0.0017	−0.0009	0.0002	0.0012	−0.0014	0.0003	0.0007
	−1.15	−1.00	−0.86	−0.71	−0.69	−0.43	0.09	0.57	−0.72	0.17	0.30
Returns (m−7, m−2)	−0.0002	−0.0005	−0.0006	−0.0010	−0.0013	−0.0002	0.0002	0.0000	0.0002	0.0005	0.0001
	−0.94	−1.20	−1.01	−1.35	−1.46	−0.26	0.25	0.01	0.23	0.52	0.11
Turnover	−0.0003	−0.0009	−0.0012	−0.0018	−0.0020	−0.0026	−0.0020	−0.0006	−0.0012	−0.0023	−0.0032
	−1.00	−1.57	−1.59	−1.84	−1.79	−2.83	−2.11	−0.70	−1.30	−2.33	−3.09
Volatility	0.0017	0.0054	0.0025	0.0013	−0.0020	0.0054	−0.0138	−0.0169	0.0103	0.0237	0.0383
	0.31	0.53	0.19	0.08	−0.10	0.29	−0.80	−0.90	0.52	1.23	2.03
Size	0.00001	0.00004	0.0000	0.0000	0.00000	0.00010	−0.0001	−0.0003	−0.0003	−0.0003	−0.0003
	0.23	0.56	0.39	0.27	0.03	0.74	−0.71	−1.94	−1.81	−2.04	−1.97
B/M	0.00004	0.00011	0.0001	0.0002	0.00031	0.0004	0.00044	0.0002	0.0001	0.0002	0.0001
	0.52	0.79	0.68	0.86	1.10	1.56	1.59	0.81	0.44	0.60	0.40
Adj. R^2	3.58%	3.81%	3.85%	3.87%	3.80%	3.48%	2.96%	2.85%	2.91%	2.95%	2.92%

Note: This table presents the return predictability of the retail order imbalances of pleasant (P), unpleasant hot (UH), and cold (UC) firms. The sample period is January 2010 to December 2018. We estimate Equation (3) using the Fama-MacBeth procedure, considering retail order imbalances of firms exhibiting pleasant and unpleasant hot and cold weather. The *UH dummy* and *UC dummy* is one when the degree days above 30°C and below 0°C exist, respectively, and zero, otherwise. The dependent variables include the short-run and w-weeks ahead returns. The independent variables consist of the past week's pleasant and unpleasant order imbalances and returns and the past one and six-month returns. As control variables, we include the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 6: Analysts' Earnings Forecast Error Predictability of Retail Pleasant and Unpleasant Firms

	[1, 2]	**[1, 3]**	**[1, 5]**	**[6, 20]**
Constant	−6.6520	−6.2913	−5.7306	−6.2018
	−31.04	−25.04	−22.05	−32.55
Order imbalances [0] * P dummy	0.2366	0.1906	0.1560	0.0233
	8.83	7.97	7.72	2.02
Order imbalances [0] * UH dummy	0.3063	0.2554	0.1994	0.0432
	4.63	4.60	4.05	1.39
Order imbalances [0] * UC dummy	0.1577	0.1579	0.1005	−0.00001
	3.03	4.10	3.21	−0.0003
Returns [0]	0.2059	0.2641	0.2826	−0.1707
	0.82	1.37	1.45	−1.24
Returns [−5, −1]	0.2769	0.1584	0.0460	−0.1159
	1.93	1.18	0.35	−0.95
Returns [−26, −6]	−0.0259	−0.0695	−0.0574	−0.0057
	−0.28	−0.81	−0.70	−0.09
Size	0.1695	0.1629	0.1540	0.1932
	15.52	12.78	11.16	18.63
B/M	−0.0145	−0.0304	−0.0591	−0.0954
	−1.12	−2.20	−4.38	−8.10
Adj. R^2	1.15%	1.45%	2.09%	3.57%

Note: This table presents the analysts' earnings forecast error predictability of the retail order imbalances of pleasant (P) and unpleasant hot (UH) and cold (UC) firms. The sample period is January 2010 to December 2018. We estimate Equation (4) using the Fama-MacBeth procedure with the logistic regression model considering firms exhibiting pleasant and unpleasant hot and cold weather. The $P\,dummy$, $UH\,dummy$, and $UC\,dummy$ is one when the degree days above 30°C and below 0°C are zero, degree days above 30°C and below 0°C exist, respectively, and zero, otherwise. The forecast error is the difference between actual earnings-per-share and the median I/B/E/S analyst forecast. The dependent variable is the forecast error dummy, which equals one when the forecast error over days $t + x$ and $t + y$ is positive and zero otherwise. The independent variables include the order imbalances and returns on day zero and the previous week's and month's returns. As control variables, we consider the previous month's size (i.e., the logarithm of market capitalization) and the logarithm of book-to-market (B/M). Following Kelley and Tetlock (2013), we require at least fifty earnings announcements for each daily logistic regression. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 7: Decomposition of Return Predictability of Retail Pleasant and Unpleasant Firms

Panel A	
Constant	−0.1006
	−19.58
Order imbalances (w−2) * P dummy	0.1400
	37.36
Order imbalances (w−2) * UH dummy	0.1319
	23.50
Order imbalances (w−2) * UC dummy	0.1277
	21.13
Returns (w−2)	−0.4220
	−16.27
Returns (m−1)	−0.2104
	−11.29
Returns (m−7, m−2)	−0.0467
	−7.36
Adj. R^2	2.44%

(continued)

Table 7 (continued): Decomposition of Return Predictability of Retail Pleasant and Unpleasant Firms

Panel B	
Constant	0.0034
	1.21
P Persistence (w−1)	0.0045
	2.40
UH Persistence (w−1)	0.0179
	1.09
UC Persistence (w−1)	−0.0044
	−0.55
Contrarian (w−1)	−0.0227
	−0.88
Other (w−1)	0.00088
	11.65
Returns (w−1)	−0.0342
	−9.07
Returns (m−1)	−0.0068
	−0.66
Returns (m−7, m−2)	0.0010
	0.38
Turnover	−0.0020
	−1.79
Volatility	−0.0021
	−0.11
Size	0.0000
	0.08
B/M	0.0003
	1.17
Adj. R^2	3.95%

Note: This table presents the decomposition of one-week ahead return predictability of the retail order imbalances considering those of pleasant (P), unpleasant hot (UH), and cold (UC) firms. The sample period is January 2010 to December 2018. Panels A and B report the estimates of Equations (5) and (8) using the Fama-MacBeth procedure considering firms exhibiting pleasant and unpleasant hot and cold weather. The $P\,dummy$, $UH\,dummy$, and $UC\,dummy$ is one when the degree days above 30°C and below 0°C are zero, degree days above 30°C and below 0°C exist, respectively, and zero, otherwise. The dependent variable is the one-week-ahead returns, and the independent variables consist of the past week's pleasant and unpleasant order imbalances and returns and the past one and six-month returns. Equation (5) decomposes the order imbalances into five components as Equation (6) shows, i.e., P persistence, UH persistence, UC persistence, contrarian, and other order imbalance measures reflecting the price pressure, liquidity provision hypothesis, and the future returns' private information, respectively. As control variables, we include the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 8: Strategy Returns of Pleasant and Unpleasant Firms

Panel A	w=1						w=2						w=4						w=6					
	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC	P − UH	P − UC	UH − UC
Q1	0.2226	0.0658	0.2313	0.0776	0.0303	−0.0912	0.4573	0.2440	0.5022	0.0946	0.0532	−0.1217	1.0080	0.5552	1.1047	0.1990	0.0738	−0.1825	1.5094	0.9471	1.5939	0.1948	0.0892	−0.1432
	2.72	0.63	2.44	1.41	0.57	−1.06	3.43	1.54	3.39	1.16	0.63	−0.95	5.28	2.42	5.14	1.81	0.67	−1.06	6.73	3.49	6.05	1.52	0.62	−0.69
Q2	0.2401	0.1438	0.2337	0.0485	0.0371	0.0092	0.4944	0.3440	0.5431	0.0605	0.0076	−0.0589	1.0224	0.7547	1.1823	0.0047	−0.0124	−0.0122	1.5134	1.1117	1.7378	−0.0034	−0.0625	−0.0845
	2.99	1.37	2.18	0.90	0.50	0.08	4.00	2.15	3.42	0.79	0.08	−0.40	5.82	3.19	5.07	0.04	−0.09	−0.06	7.21	3.95	5.98	−0.02	−0.37	−0.33
Q3	0.2807	0.2385	0.3812	0.0095	−0.0867	−0.1734	0.5541	0.3934	0.7973	0.0972	−0.1935	−0.4668	1.0919	0.7434	1.7416	0.1123	−0.5095	−0.9680	1.6730	1.0579	2.2070	0.2902	−0.3800	−1.0093
	3.41	2.28	3.66	0.19	−1.30	−1.69	4.36	2.53	4.92	1.39	−1.88	−3.15	6.07	3.34	7.14	1.08	−3.16	−4.18	7.78	3.95	7.60	2.39	−2.06	−3.88
Q4	0.3205	0.2013	0.4634	0.0839	−0.1389	−0.2847	0.5814	0.3968	0.8744	0.1338	−0.2375	−0.4732	1.1952	0.6925	1.5540	0.2881	−0.2403	−0.6300	1.8167	1.0945	2.0346	0.4232	−0.1487	−0.6136
	3.79	2.00	4.14	1.67	−1.95	−2.75	4.45	2.44	5.04	1.68	−2.17	−2.88	6.55	2.91	6.42	2.53	−1.53	−2.63	8.34	3.82	6.34	3.26	−0.69	−1.92
Q5	0.3337	0.2861	0.2385	0.0231	0.1224	0.1042	0.6443	0.5530	0.5668	0.0488	0.1455	0.1262	1.2945	1.0017	1.4296	0.1227	0.0458	−0.0431	1.8745	1.5264	1.9841	0.0778	0.1228	0.0724
	4.03	2.68	2.26	0.38	1.98	0.98	4.99	3.46	3.51	0.58	1.62	0.86	6.95	4.25	6.06	0.94	0.32	−0.19	8.52	5.55	6.75	0.51	0.73	0.26
Q4 − Q1	0.0979	0.1065	0.2093	0.0271	−0.1650	−0.2132	0.1240	0.1387	0.3312	0.0496	−0.3215	−0.4128	0.1873	0.1584	0.3467	0.0999	−0.2950	−0.4600	0.3073	0.1307	0.3270	0.2684	−0.2046	−0.4992
	2.69	1.69	2.72	0.40	−2.01	−1.66	2.07	1.47	2.59	0.47	−2.37	−2.04	2.25	1.17	1.96	0.69	−1.57	−1.59	2.96	0.84	1.32	1.64	−0.79	−1.30
Q5 − Q1	0.1111	0.1837	−0.0142	−0.0247	0.1032	0.1911	0.1870	0.2507	0.0589	0.0085	0.0648	0.1648	0.2865	0.4273	0.2363	−0.0616	0.0121	0.1954	0.3652	0.4943	0.2792	−0.0417	0.0581	0.1628
	3.07	2.57	−0.20	−0.31	1.32	1.36	3.12	2.50	0.56	0.08	0.57	0.85	3.37	2.97	1.56	−0.39	0.07	0.69	3.55	2.67	1.51	−0.21	0.28	0.47

(continued)

Table 8 (continued): Strategy Returns of Pleasant and Unpleasant Firms

	w=8						w=10						w=12					
	P	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**	**P**	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**	**P**	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**
Q1	1.9406	1.4048	2.1413	0.1450	−0.0125	−0.2411	2.4600	1.8790	2.6460	0.1652	−0.0538	−0.2725	3.0072	2.4258	3.2148	0.0992	−0.0379	−0.1944
	7.58	4.37	7.05	0.82	−0.08	−0.89	8.44	5.18	7.61	0.84	−0.28	−0.87	9.76	6.29	8.33	0.48	−0.18	−0.57
Q2	1.9664	1.5006	2.3244	0.0499	−0.2125	−0.3409	2.5184	2.0029	2.6282	0.0655	0.0017	−0.0961	3.0642	2.5196	3.2071	0.0158	−0.0355	−0.1210
	8.32	4.79	7.11	0.31	−1.14	−1.19	9.35	5.46	6.94	0.35	0.01	−0.29	10.73	6.36	7.85	0.08	−0.15	−0.33
Q3	2.2553	1.4933	2.7504	0.4412	−0.3374	−1.0985	2.8786	2.0333	3.3304	0.5105	−0.3313	−1.1141	3.5372	2.5632	4.0487	0.6111	−0.4311	−1.3067
	9.43	4.74	8.10	2.83	−1.55	−3.57	10.85	5.67	8.51	2.93	−1.28	−3.15	12.39	6.54	9.42	3.14	−1.52	−3.33
Q4	2.4140	1.5380	2.6544	0.5691	−0.1652	−0.8065	2.9668	1.9938	3.2985	0.6644	−0.2435	−0.9998	3.6291	2.6624	4.0225	0.5749	−0.3313	−1.0064
	10.24	4.70	7.53	3.76	−0.69	−2.33	11.29	5.43	8.54	3.99	−0.93	−2.65	12.94	6.83	9.80	3.15	−1.14	−2.41
Q5	2.4618	2.1396	2.5528	0.0098	0.1559	0.1657	3.0359	2.7649	3.1124	−0.1122	0.2283	0.3542	3.6786	3.3715	3.7788	−0.1404	0.1553	0.3423
	9.86	6.88	7.56	0.06	0.79	0.53	10.68	7.83	8.06	−0.61	1.03	1.02	12.19	8.93	8.94	−0.75	0.63	0.91
Q4 − Q1	0.4734	0.1495	0.3220	0.4216	−0.0708	−0.4627	0.5068	0.1406	0.3492	0.4597	−0.0216	−0.4818	0.6219	0.2344	0.5888	0.4732	−0.1329	−0.6395
	3.94	0.84	1.19	2.21	−0.25	−1.13	3.79	0.70	1.10	2.21	−0.07	−1.05	4.33	1.09	1.65	2.13	−0.38	−1.28
Q5 − Q1	0.5212	0.6752	0.2842	−0.0960	0.2032	0.4353	0.5759	0.8091	0.3011	−0.2509	0.3062	0.6577	0.6714	0.8701	0.4285	−0.2272	0.2861	0.6586
	4.56	3.21	1.30	−0.43	0.84	1.08	4.44	3.51	1.26	−1.03	1.13	1.48	4.73	3.63	1.55	−0.90	0.95	1.37

Panel B

	P	**UH**	**UC**
Q1	−1.660	−1.634	−1.681
Q2	−0.5976	−0.5899	−0.5985
Q3	−0.1004	−0.0960	−0.1007
Q4	0.3499	0.3561	0.3515
Q5	1.331	1.311	1.334

Note: This table presents the w-weeks ahead quintile portfolio returns and the long−short strategy returns of pleasant (P) and unpleasant hot (UH) and cold (UC) firms. In particular, each day, using the previous week's retail order imbalance, we sort firms into quintiles, and then for each quintile, we consider the firms exhibiting pleasant and unpleasant hot and cold weather. The long−short strategy consists of buying the stocks in the highest order imbalance quintile (Q5 or Q4) and selling stocks in the lowest order imbalance quintile (Q1). The sample period is January 2010 to December 2018. Panel A reports the percentage value-weighted portfolio returns based on the previous month's market capitalization. Panel B presents the average retail order imbalances over the quintile. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 9: Return Comovement Estimates on the Low and High Return Portfolios and their Relationship with Pleasant and Unpleasant Firms

	P	UH	UC	P − UH	P − UC	UH − UC
Panel A						
Low return comovement	1.0172	1.0867	1.1089	−0.0771	−0.0892	−0.0414
	289.85	109.07	88.06	−7.77	−6.52	−1.98
High return comovement	0.9611	1.0309	1.0581	−0.0797	−0.0957	−0.0507
	252.48	110.45	82.88	−7.99	−6.88	−2.50
High − Low comovement	−0.0561	−0.0558	−0.0508			
	−13.90	−11.68	−11.36			
Panel B						
Low return comovement	1.0586	1.1030	1.0692	−0.0571	−0.0032	0.0401
	103.91	79.50	83.78	−7.91	−0.37	2.93
High return comovement	0.9955	1.0395	1.0076	−0.0584	−0.0080	0.0351
	108.78	81.94	87.14	−8.51	−0.94	2.73
High − Low comovement	−0.0630	−0.0634	−0.0616			
	−13.85	−12.39	−12.60			

Note: This table presents the relationship between the return comovement estimates on the low and high return portfolios and the pleasant (P) and unpleasant hot (UH) and cold (UC) firms. In particular, we sort firms into two groups each day using the previous week's retail order imbalance. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. We compute the value-weighted portfolio returns based on the previous month's market capitalization. The sample period is January 2010 to December 2018. Following Goetzmann et al. (2015), we redesign the return comovement analysis to accommodate our context (Green and Hwang, 2009; Kumar et al., 2013). Specifically, we obtain the daily return comovement coefficients by using a forward-looking 30-day window to estimate the rolling regression model of Equation (9) for each low and high portfolio. The dependent variable is the firm's returns, and the independent variable includes the portfolio returns. Panel A reports the value-weighted comovement coefficients based on the previous month's market capitalization for pleasant and unpleasant firms, whereas Panel B reports the equal-weighted comovement coefficients. We also report the return comovement difference between pleasant and unpleasant firms, e.g., P−UH, P−UC, and UH−UC. The high−low comovement captures the difference between high and low return comovement coefficients. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 10: Pleasant and Unpleasant Return Comovement Estimates on the Pleasant and Unpleasant Low and High Return Portfolios and their Relationship with P, UH, and UC Firms

	Low						High						High − Low comovement		
	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC
Panel A															
Pleasant comovement	0.9524	1.0103	1.0247	−0.0579	−0.0706	−0.0411	0.9142	0.9688	0.9823	−0.0586	−0.0665	−0.0399	−0.0382	−0.0415	−0.0424
	154.95	86.12	72.85	−6.30	−5.37	−2.09	196.18	95.70	76.07	−6.26	−5.18	−2.11	−6.78	−5.58	−4.92
Unpleasant hot comovement	0.7567	0.8617	0.8300	−0.0700	−0.0983	−0.0400	0.6975	0.7978	0.7782	−0.0721	−0.1072	−0.0505	−0.0593	−0.0630	−0.0517
	53.58	70.71	35.73	−10.82	−7.32	−2.31	48.54	60.58	34.64	−10.24	−8.06	−3.00	−6.36	−5.73	−4.09
Unpleasant cold comovement	0.7002	0.6901	0.8035	−0.0686	−0.0720	−0.0261	0.6804	0.6789	0.7888	−0.0732	−0.0868	−0.0437	−0.0313	−0.0252	−0.0176
	43.77	31.08	59.51	−7.18	−8.41	−1.66	47.62	33.94	69.08	−7.83	−9.41	−2.82	−4.78	−2.69	−1.52
Panel B															
Pleasant comovement	0.9853	1.0319	0.9875	−0.0499	0.0052	0.0435	0.9359	0.9809	0.9411	−0.0502	0.0011	0.0386	−0.0494	−0.0509	−0.0464
	88.19	66.94	72.33	−7.34	0.62	3.37	106.21	75.80	81.47	−7.37	0.13	3.13	−7.34	−6.12	−5.91
Unpleasant hot comovement	0.7838	0.8733	0.7792	−0.0537	−0.0181	0.0289	0.7243	0.8067	0.7188	−0.0515	−0.0206	0.0234	−0.0599	−0.0652	−0.0609
	55.45	58.67	40.62	−11.46	−2.03	2.54	49.97	52.01	39.18	−10.66	−2.36	2.09	−6.13	−5.86	−5.35
Unpleasant cold comovement	0.7675	0.7256	0.8090	−0.0392	−0.0095	0.0152	0.7400	0.7018	0.7677	−0.0418	−0.0046	0.0220	−0.0388	−0.0365	−0.0449
	44.89	35.37	54.13	−5.69	−1.55	1.39	46.64	37.45	53.26	−6.11	−0.81	2.10	−5.24	−3.58	−5.50

Note: This table presents the relationship between the pleasant and unpleasant return comovement estimates on the pleasant and unpleasant low and high return portfolios and their relationship with pleasant (P) and unpleasant hot (UH) and cold (UC) firms. In particular, each day, we sort firms into two groups using the previous week's retail order imbalance, and then for each group, we consider the firms exhibiting P, UH, and UC weather. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. We compute the value-weighted portfolio returns based on the previous month's market capitalization. The sample period is January 2010 to December 2018. Following Goetzmann et al. (2015), we redesign the return comovement analysis to accommodate our context (Green and Hwang, 2009; Kumar et al., 2013). Specifically, we obtain the daily pleasant and unpleasant return comovement coefficients by using a forward-looking 30-day window to estimate a similar rolling regression model as in Equation (10) for each of the pleasant and unpleasant low and high portfolios. The dependent variable is the firm's returns, and the independent variable includes the portfolio returns. Panel A reports the value-weighted pleasant and unpleasant comovement coefficients based on the previous month's market capitalization for pleasant and unpleasant firms, whereas Panel B reports the equal-weighted comovement coefficients. We also report the pleasant and unpleasant return comovement difference between pleasant and unpleasant firms, e.g., P−UH, P−UC, and UH−UC. The high−low comovement captures the difference between high and low return comovement coefficients. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 11: Order Imbalance Comovement Estimates on the Low and High Order Imbalances Portfolios and their Relationship with Pleasant and Unpleasant Firms

	P	UH	UC	P − UH	P − UC	UH − UC
Panel A						
Low imbalances comovement	0.5483	0.5923	0.7116	−0.0514	−0.1794	−0.1416
	22.62	11.09	8.51	−0.98	−2.12	−1.18
High imbalances comovement	0.5103	0.5815	0.6914	−0.0746	−0.1951	−0.1514
	19.21	11.58	10.55	−1.58	−3.01	−1.58
High − Low comovement	−0.0380	−0.0108	−0.0202			
	−1.90	−0.30	−0.33			
Panel B						
Low imbalances comovement	0.7267	0.7677	0.9299	−0.0546	−0.2104	−0.1962
	60.11	17.52	12.33	−1.24	−2.83	−1.80
High imbalances comovement	0.7404	0.8215	0.8288	−0.0978	−0.0887	0.0062
	63.85	17.61	14.04	−2.19	−1.50	0.07
High − Low comovement	0.0136	0.0538	−0.1012			
	1.37	1.95	−1.73			

Note: This table presents the relationship between the retail order imbalances comovement estimates on the low and high order imbalance portfolios and their relationship with pleasant (P), unpleasant hot (UH), and cold (UC) firms. In particular, we sort firms into two groups each day using the previous week's retail order imbalance. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. We compute the equal-weighted order imbalance portfolios. The sample period is January 2010 to December 2018. Following Goetzmann et al. (2015), we redesign the return comovement analysis to accommodate our context (Green and Hwang, 2009; Kumar et al., 2013). Specifically, we obtain the daily order imbalance comovement coefficients by using a forward-looking 30-day window to estimate a similar rolling contemporaneous regression model as in Equation (11) for each low and high portfolio. The dependent variable is the firm's order imbalance, and the independent variable includes the retail order imbalance portfolio. Panel A reports the value-weighted order imbalance comovement coefficients based on the previous month's market capitalization for pleasant and unpleasant firms, whereas Panel B reports the equal-weighted comovement coefficients. We also report the pleasant and unpleasant imbalance comovement difference between pleasant and unpleasant firms, e.g., P−UH, P−UC, and UH−UC. The high−low comovement captures the difference between high and low order imbalance coefficients. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Table 12: Pleasant and Unpleasant Order Imbalances Comovement Estimates on the Pleasant and Unpleasant Low and High Order Imbalances Portfolios and their Relationship with P, UH, and UC Firms

	Low						High						High − Low comovement		
	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC
Panel A															
Pleasant comovement	0.4648	0.4771	0.6209	−0.0362	−0.1611	−0.1535	0.4208	0.4777	0.5616	−0.0727	−0.1386	−0.0950	−0.0440	0.0006	−0.0593
	23.03	9.76	11.79	−0.75	−3.07	−1.79	20.34	10.69	11.29	−1.72	−2.78	−1.22	−2.91	0.01	−1.31
Unpleasant hot comovement	0.2584	0.2709	0.3979	0.0113	−0.1763	−0.2197	0.2570	0.3035	0.3620	−0.0210	−0.1477	−0.1442	−0.0016	0.0335	−0.0368
	13.92	12.87	4.53	0.64	−2.04	−2.25	13.39	13.38	5.71	−1.20	−2.40	−2.03	−0.10	1.60	−0.55
Unpleasant cold comovement	0.2497	0.2452	0.3028	−0.0586	−0.0356	0.0283	0.2478	0.2577	0.3100	−0.0593	−0.0442	0.0227	−0.0076	0.0061	0.0058
	11.30	6.17	14.30	−1.63	−2.16	0.69	9.95	5.79	13.45	−1.50	−2.63	0.49	−0.40	0.24	0.33
Panel B															
Pleasant comovement	0.6231	0.6213	0.7600	−0.0113	−0.1359	−0.1563	0.6071	0.6672	0.6572	−0.0762	−0.0453	0.0318	−0.0160	0.0459	−0.1029
	50.56	14.32	16.25	−0.26	−2.99	−2.03	51.67	15.62	14.28	−1.93	−1.01	0.42	−1.79	1.43	−2.68
Unpleasant hot comovement	0.3219	0.4118	0.4809	−0.0546	−0.2035	−0.1659	0.3435	0.4423	0.3822	−0.0631	−0.0792	−0.0185	0.0211	0.0315	−0.1011
	17.98	21.79	5.55	−4.14	−2.50	−1.71	20.52	23.49	6.73	−4.38	−1.52	−0.30	2.43	2.19	−1.33
Unpleasant cold comovement	0.3382	0.3059	0.4260	−0.0535	−0.0620	−0.0114	0.3470	0.2981	0.4237	−0.0522	−0.0514	−0.0001	−0.0001	−0.0182	−0.0052
	19.57	7.96	23.73	−1.57	−5.30	−0.29	17.93	6.50	20.86	−1.32	−3.93	0.00	−0.01	−0.64	−0.41

Note: This table presents the relationship between the pleasant and unpleasant order imbalance comovement estimates on the pleasant and unpleasant low and high order imbalance portfolios and their relationship with pleasant (P) and unpleasant hot (UH) and cold (UC) firms. In particular, each day, we sort firms into two groups using the previous week's retail order imbalance, and then for each group, we consider the firms exhibiting P, UH, and UC weather. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. We compute the equal-weighted order imbalance portfolios. The sample period is January 2010 to December 2018. Following Goetzmann et al. (2015), we redesign the return comovement analysis to accommodate our context (Green and Hwang, 2009; Kumar et al., 2013). Specifically, we obtain the daily pleasant and unpleasant order imbalance comovement coefficients by using a forward-looking 30-day window to estimate a similar rolling regression model as in Equation (12) for each of the pleasant and unpleasant low and high portfolios. The dependent variable is the firm's order imbalances, and the independent variable includes the order imbalance portfolio. Panel A reports the value-weighted pleasant and unpleasant order imbalance comovement coefficients based on the previous month's market capitalization for pleasant and unpleasant firms, whereas Panel B reports the equal-weighted comovement coefficients. We also report the pleasant and unpleasant imbalance comovement difference between pleasant and unpleasant firms, e.g., P−UH, P−UC, and UH−UC. The high−low comovement captures the difference between high and low order imbalance coefficients. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.1: Determinants of Retail Order Imbalances

Constant	−0.3706
	−12.85
UH dummy	0.0120
	2.87
Order imbalances (w−1) * UH dummy	−0.0027
	−0.52
UC dummy	−0.0035
	−0.64
Order imbalances (w−1) * UC dummy	−0.0103
	−1.99
Order imbalances (w−1)	0.1335
	35.19
Returns (w−1)	−0.6446
	−19.69
Returns (m−1)	−0.2366
	−13.28
Returns (m−7, m−2)	−0.0534
	−8.48
Turnover	0.0134
	2.20
Volatility	0.2554
	2.14
Size	0.01215
	9.03
B/M	−0.01532
	−8.95
Adj. R^2	2.56%

Note: This table presents the retail investors' trading activity determinants considering the past imbalances of pleasant (P) and unpleasant hot (UH) and cold (UC) firms. The sample period is January 2010 to December 2018. We estimate a similar regression as in Equation (1) using the Fama-MacBeth procedure considering retail order imbalances of firms exhibiting pleasant and unpleasant hot and cold weather. The *UH dummy* and *UC dummy* is one when degree days above 30°C and below 0°C exist and zero, otherwise. The dependent variable is the one-week ahead retail order imbalance measure. The independent variables consist of the past week's pleasant and unpleasant order imbalances and returns and the past one and six-month returns. As control variables, we include the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.2: Determinants of Retail Order Imbalances for Pleasant and Unpleasant Firms

	P	UH	UC
Constant	−0.3571	−0.4015	−0.3056
	−15.83	−10.47	−7.69
Order imbalances (w−1)	0.1366	0.1339	0.1312
	52.88	33.92	33.37
Returns (w−1)	−0.6979	−0.7344	−0.7090
	−24.65	−17.92	−15.06
Returns (m−1)	−0.2496	−0.2367	−0.2020
	−17.16	−10.10	−7.10
Returns (m−7, m−2)	−0.0428	−0.0326	−0.0541
	−7.79	−3.54	−4.52
Turnover	0.0160	0.0412	0.0359
	2.48	3.07	2.39
Volatility	0.3808	0.2145	0.3572
	3.64	1.44	2.54
Size	0.0110	0.0134	0.0082
	10.64	7.70	4.17
B/M	−0.0153	−0.01439	−0.0216
	−9.50	−5.30	−6.64
Adj. R^2	2.62%	2.50%	2.24%

NNote: This table presents the retail investors' trading activity determinants for pleasant (P) and unpleasant hot (UH) and cold (UC) firms. The sample period is January 2010 to December 2018. We estimate Equation (1) using the Fama-MacBeth procedure for each subgroup of firms exhibiting pleasant and unpleasant hot and cold weather. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. The dependent variable is the one-week ahead retail order imbalance measure. The independent variables consist of the past week's order imbalances and returns and the past one and six-month returns. As control variables, we include the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.3: Retail Return Predictability of Pleasant and Unpleasant Firms

	P	UH	UC
Constant	0.0054	0.0094	0.0007
	2.44	2.21	0.16
Order imbalances (w−1)	0.0009	0.0009	0.0008
	11.43	4.42	4.00
Returns (w−1)	−0.0327	−0.0334	−0.0304
	−9.65	−5.83	−4.65
Returns (m−1)	−0.0049	−0.0024	−0.0066
	−2.70	−0.81	−1.70
Returns (m−7, m−2)	−0.0001	0.0000	0.0008
	−0.17	0.03	0.50
Turnover	−0.0021	−0.0046	−0.0066
	−2.23	−2.09	−2.20
Volatility	0.0294	−0.0115	0.0138
	1.96	−0.41	0.35
Size	−0.0001	−0.0003	0.0002
	−1.13	−1.34	0.92
B/M	0.0002	0.00039	0.0005
	0.68	1.21	1.12
Adj. R^2	4.70%	7.14%	9.10%

Note: This table presents the one-week-ahead return predictability of the retail order imbalances for pleasant (P) and unpleasant hot (UH) and cold (UC) firms. The sample period is January 2010 to December 2018. We estimate Equation (2) using the Fama-MacBeth procedure for each subgroup of firms exhibiting pleasant and unpleasant hot and cold weather. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. The dependent variable is the one-week-ahead returns, and the independent variables include the order imbalances and returns over the previous week and the previous month and six-month returns. As control variables, we consider the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.4: Decomposition of Retail Return Predictability of Pleasant and Unpleasant Firms

Panel A			
	P	**UH**	**UC**
Constant	−0.1093	−0.1004	−0.1168
	−24.46	−19.04	−16.94
Order imbalances (w−2)	0.1407	0.1365	0.1316
	54.75	34.19	29.18
Returns (w−2)	−0.4515	−0.4964	−0.4269
	−17.42	−9.46	−7.90
Returns (m−1)	−0.2149	−0.2137	−0.2063
	−13.71	−7.53	−5.89
Returns (m−7, m−2)	−0.0368	−0.0298	−0.0438
	−6.77	−3.14	−3.14
Adj. R^2	2.52%	2.71%	2.04%

(continued)

Appendix A.4 (continued): Decomposition of Retail Return Predictability of Pleasant and Unpleasant Firms

Panel B			
	P	**UH**	**UC**
Constant	0.0057	0.0088	−0.0008
	2.61	2.08	−0.18
Persistence (w−1)	0.0037	−0.0026	−0.0054
	3.21	−0.58	−0.54
Contrarian (w−1)	0.0052	0.027	−0.0142
	0.29	1.30	−0.69
Other (w−1)	0.00082	0.00082	0.00076
	10.93	3.73	3.60
Returns (w−1)	−0.0314	−0.0315	−0.0278
	−9.35	−5.56	−3.68
Returns (m−1)	−0.0047	−0.0049	−0.0198
	−0.71	−0.47	−1.45
Returns (m−7, m−2)	0.0034	−0.001	−0.0004
	1.73	−0.31	−0.08
Turnover	−0.0022	−0.0040	−0.0065
	−2.38	−1.87	−2.25
Volatility	0.0253	0.0009	0.0343
	1.72	0.03	0.97
Size	−0.0001	−0.0003	0.0003
	−1.22	−1.30	1.17
B/M	0.0002	0.00038	0.0002
	0.73	1.16	0.45
Adj. R^2	5.06%	7.69%	9.31%

Note: This table presents the decomposition of one-week ahead return predictability of the retail order imbalances for pleasant (P) and unpleasant hot (UH) and cold (UC) firms. The sample period is January 2010 to December 2018. Panels A and B report the estimates of Equations (5) and (8) using the Fama-MacBeth procedure or each subgroup of firms exhibiting pleasant and unpleasant hot and cold weather. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. The dependent variable is the one-week-ahead returns, and the independent variables consist of the past week's order imbalances and returns and the past one and six-month returns. For each subgroup of firms, we decompose the order imbalances into three components, i.e., persistence, contrarian, and other order imbalance measures reflecting the price pressure, liquidity provision hypothesis, and the future returns' private information, respectively. As control variables, we include the previous month's turnover, volatility of daily returns, size (i.e., the logarithm of market capitalization), and the logarithm of book-to-market (B/M). We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.5: Strategy Alphas of Pleasant and Unpleasant Firms

Panel A	w=1						w=2						w=4						w=6					
	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC	P − UH	P − UC	UH − UC	P	UH	UC	P − UH	P − UC	UH − UC
Q1	0.2297	0.0693	0.2410	0.0786	0.0275	−0.0979	0.4661	0.2483	0.5103	0.0948	0.0548	−0.1250	1.0254	0.5609	1.1156	0.2054	0.0765	−0.1922	1.5257	0.9577	1.6012	0.1970	0.0952	−0.1475
	2.73	0.66	2.48	1.44	0.51	−1.15	3.45	1.56	3.41	1.16	0.65	−0.98	5.35	2.45	5.19	1.86	0.70	−1.12	6.78	3.51	6.09	1.53	0.66	−0.72
Q2	0.2450	0.1481	0.2365	0.0489	0.0370	0.0051	0.5022	0.3498	0.5457	0.0603	0.0095	−0.0586	1.0354	0.7637	1.1812	0.0064	−0.0051	−0.0084	1.5263	1.1192	1.7394	−0.0012	−0.0578	−0.0851
	2.99	1.39	2.18	0.91	0.49	0.04	4.01	2.16	3.42	0.79	0.10	−0.40	5.86	3.22	5.06	0.05	−0.04	−0.04	7.24	3.97	5.96	−0.01	−0.34	−0.33
Q3	0.2887	0.2448	0.3888	0.0090	−0.0873	−0.1722	0.5649	0.3979	0.8143	0.0991	−0.2009	−0.4744	1.1078	0.7521	1.7596	0.1137	−0.5170	−0.9722	1.6892	1.0711	2.2176	0.2873	−0.3812	−1.0045
	3.43	2.30	3.66	0.18	−1.30	−1.69	4.39	2.53	4.95	1.42	−1.95	−3.21	6.13	3.35	7.16	1.09	−3.20	−4.21	7.81	3.98	7.58	2.36	−2.06	−3.86
Q4	0.3287	0.2097	0.4693	0.0830	−0.1387	−0.2810	0.5913	0.4051	0.8780	0.1321	−0.2339	−0.4673	1.2126	0.7043	1.5570	0.2888	−0.2303	−0.6210	1.8357	1.1092	2.0352	0.4238	−0.1368	−0.5996
	3.79	2.04	4.16	1.65	−1.95	−2.72	4.47	2.47	5.06	1.66	−2.14	−2.87	6.60	2.96	6.42	2.54	−1.45	−2.60	8.39	3.86	6.34	3.27	−0.64	−1.89
Q5	0.3404	0.2927	0.2441	0.0209	0.1236	0.1037	0.6539	0.5581	0.5777	0.0480	0.1454	0.1258	1.3088	1.0115	1.4421	0.1217	0.0474	−0.0374	1.8876	1.5354	1.9867	0.0763	0.1335	0.0850
	4.02	2.71	2.29	0.34	1.99	0.98	5.00	3.48	3.54	0.57	1.60	0.86	6.99	4.27	6.03	0.94	0.32	−0.16	8.54	5.57	6.67	0.51	0.77	0.31
Q4 − Q1	0.0990	0.1095	0.2066	0.0266	−0.1621	−0.2047	0.1251	0.1413	0.3285	0.0490	−0.3188	−0.4069	0.1872	0.1663	0.3416	0.0917	−0.2886	−0.4433	0.3100	0.1386	0.3213	0.2630	−0.1959	−0.4802
	2.69	1.73	2.70	0.39	−1.97	−1.61	2.09	1.49	2.58	0.47	−2.36	−2.03	2.24	1.23	1.93	0.64	−1.53	−1.54	2.99	0.89	1.31	1.60	−0.75	−1.26
Q5 − Q1	0.1107	0.1856	−0.0191	−0.0266	0.1077	0.1963	0.1877	0.2502	0.0598	0.0095	0.0652	0.1670	0.2834	0.4320	0.2371	−0.0688	0.0113	0.2101	0.3620	0.4953	0.2754	−0.0469	0.0628	0.1795
	3.06	2.62	−0.26	−0.34	1.38	1.40	3.14	2.49	0.57	0.09	0.57	0.86	3.33	3.02	1.55	−0.44	0.07	0.74	3.53	2.68	1.49	−0.24	0.30	0.52

(continued)

Appendix A.5 (continued): Strategy Alphas of Pleasant and Unpleasant Firms

	w=8						w=10						w=12					
	P	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**	**P**	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**	**P**	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**
Q1	1.9540	1.4164	2.1518	0.1424	−0.0094	−0.2423	2.4795	1.8924	2.6591	0.1644	−0.0499	−0.2769	3.0293	2.4373	3.2303	0.1021	−0.0358	−0.1989
	7.60	4.37	7.10	0.79	−0.06	−0.89	8.47	5.18	7.63	0.82	−0.26	−0.88	9.83	6.30	8.39	0.49	−0.17	−0.58
Q2	1.9780	1.5059	2.3258	0.0513	−0.2068	−0.3435	2.5356	2.0084	2.6397	0.0702	0.0016	−0.1038	3.0830	2.5263	3.2148	0.0199	−0.0333	−0.1277
	8.34	4.80	7.08	0.32	−1.10	−1.20	9.37	5.45	6.92	0.38	0.01	−0.32	10.78	6.37	7.82	0.10	−0.13	−0.34
Q3	2.2711	1.4978	2.7660	0.4458	−0.3422	−1.1047	2.9045	2.0435	3.3572	0.5155	−0.3404	−1.1234	3.5671	2.5808	4.0705	0.6124	−0.4337	−1.3069
	9.46	4.75	8.10	2.86	−1.57	−3.60	10.89	5.69	8.52	2.98	−1.32	−3.18	12.49	6.60	9.44	3.17	−1.52	−3.34
Q4	2.4308	1.5479	2.6539	0.5721	−0.1506	−0.7994	2.9889	2.0099	3.3092	0.6642	−0.2366	−0.9938	3.6521	2.6757	4.0306	0.5794	−0.3264	−1.0080
	10.27	4.74	7.51	3.78	−0.63	−2.31	11.33	5.46	8.54	3.99	−0.89	−2.64	13.03	6.88	9.79	3.17	−1.11	−2.41
Q5	2.4722	2.1471	2.5516	0.0074	0.1704	0.1833	3.0536	2.7750	3.1091	−0.1109	0.2471	0.3741	3.7002	3.3846	3.7750	−0.1385	0.1757	0.3592
	9.85	6.90	7.47	0.04	0.84	0.58	10.69	7.86	7.97	−0.61	1.09	1.07	12.26	9.00	8.86	−0.74	0.70	0.95
Q4 − Q1	0.4768	0.1565	0.3095	0.4191	−0.0538	−0.4464	0.5094	0.1499	0.3407	0.4536	−0.0110	−0.4658	0.6228	0.2422	0.5760	0.4684	−0.1195	−0.6267
	3.96	0.88	1.14	2.20	−0.19	−1.10	3.79	0.75	1.07	2.18	−0.03	−1.02	4.32	1.13	1.60	2.11	−0.34	−1.26
Q5 − Q1	0.5182	0.6779	0.2701	−0.1009	0.2171	0.4611	0.5741	0.8118	0.2824	−0.2541	0.3249	0.6913	0.6710	0.8755	0.4043	−0.2321	0.3116	0.6946
	4.53	3.22	1.23	−0.45	0.89	1.14	4.41	3.52	1.18	−1.04	1.19	1.56	4.73	3.66	1.46	−0.91	1.02	1.44

Note: This table presents the w-weeks ahead quintile portfolio alphas and the long−short strategy alphas for the pleasant (P) and unpleasant hot (UH) and cold (UC) firms. In particular, each day, using the previous week's retail order imbalance, we sort firms into quintiles, and then for each quintile, we consider the firms exhibiting pleasant and unpleasant hot and cold weather. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. The long−short strategy consists of buying the stocks in the highest order imbalance quintile (Q5 or Q4) and selling stocks in the lowest order imbalance quintile (Q1). The sample period is January 2010 to December 2018. We report the percentage value-weighted portfolio alphas based on the previous month's market capitalization. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.6: Return Comovement Estimates on the Low and High Return Portfolios and their Relationship with Pleasant and Unpleasant Firms

	P	UH	UC	P − UH	P − UC	UH − UC
Panel A						
Low return comovement	1.0154	1.0874	1.0941	−0.0803	−0.0786	−0.0215
	369.89	126.52	119.36	−9.20	−7.75	−1.29
High return comovement	0.9604	1.0333	1.0393	−0.0812	−0.0775	−0.0248
	294.80	130.84	111.08	−9.54	−7.86	−1.58
High − Low comovement	−0.0549	−0.0540	−0.0548			
	−17.26	−13.79	−14.71			
Panel B						
Low return comovement	1.0439	1.0929	1.0524	−0.0625	−0.0028	0.0467
	127.20	93.23	109.90	−9.88	−0.42	4.08
High return comovement	0.9849	1.0329	0.9947	−0.0614	−0.0037	0.0429
	129.00	95.56	107.78	−10.57	−0.58	3.95
High − Low comovement	−0.0590	−0.0600	−0.0577			
	−16.44	−14.17	−15.64			

Note: This table presents the relationship between the return comovement estimates on the low and high return portfolios and the pleasant (P) and unpleasant hot (UH) and cold (UC) firms. In particular, we sort firms into two groups each day using the previous week's retail order imbalance. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. We compute the value-weighted portfolio returns based on the previous month's market capitalization. The sample period is January 2010 to December 2018. Following Goetzmann et al. (2015), we redesign the return comovement analysis to accommodate our context (Green and Hwang, 2009; Kumar et al., 2013). Specifically, we obtain the daily return comovement coefficients by using a forward-looking 90-day window to estimate the rolling regression model of Equation (9) for each low and high portfolio. The dependent variable is the firm's returns, and the independent variable includes the portfolio returns. Panel A reports the value-weighted comovement coefficients based on the previous month's market capitalization for pleasant and unpleasant firms, whereas Panel B reports the equal-weighted comovement coefficients. We also report the return comovement difference between pleasant and unpleasant firms, e.g., P−UH, P−UC, and UH−UC. The high−low comovement captures the difference between high and low return comovement coefficients. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.7: Pleasant and Unpleasant Return Comovement Estimates on the Pleasant and Unpleasant Low and High Return Portfolios and their Relationship with P, UH, and UC Firms

	Low						High						High − Low comovement		
	P	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**	**P**	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**	**P**	**UH**	**UC**
Pleasant comovement	0.9413	0.9996	1.0072	−0.0705	−0.0694	−0.0231	0.9086	0.9710	0.9729	−0.0724	−0.0644	−0.0211	−0.0326	−0.0285	−0.0343
	187.77	97.40	102.99	−8.58	−7.22	−1.48	231.20	123.69	99.74	−9.15	−6.68	−1.41	−7.32	−5.13	−6.64
Unpleasant hot comovement	0.7043	0.7987	0.7614	−0.0657	−0.0642	−0.0159	0.6556	0.7404	0.7187	−0.0700	−0.0620	−0.0132	−0.0537	−0.0627	−0.0492
	54.52	56.02	42.45	−11.32	−7.45	−1.22	53.13	49.28	44.12	−11.66	−8.15	−1.13	−6.98	−6.62	−5.23
Unpleasant cold comovement	0.6321	0.6428	0.7204	−0.0582	−0.0725	−0.0323	0.6208	0.6365	0.7064	−0.0578	−0.0731	−0.0351	−0.0114	−0.0064	−0.0140
	47.63	35.99	52.75	−8.49	−10.02	−2.55	53.65	40.78	58.43	−9.09	−10.26	−2.99	−2.41	−0.98	−2.49
Panel B															
Pleasant comovement	0.9672	1.0054	0.9693	−0.0569	0.0008	0.0448	0.9295	0.9724	0.9341	−0.0563	−0.0006	0.0414	−0.0377	−0.0330	−0.0353
	105.29	79.28	91.35	−9.87	0.13	4.18	124.36	92.76	99.48	−10.16	−0.09	3.95	−8.02	−5.75	−6.85
Unpleasant hot comovement	0.7287	0.8016	0.7291	−0.0484	−0.0037	0.0342	0.6752	0.7389	0.6850	−0.0515	−0.0049	0.0339	−0.0583	−0.0671	−0.0497
	59.35	55.13	48.97	−11.16	−0.70	3.93	57.07	49.77	51.00	−13.04	−0.94	4.16	−7.31	−7.01	−5.85
Unpleasant cold comovement	0.6888	0.6816	0.7223	−0.0424	−0.0159	0.0143	0.6690	0.6621	0.6925	−0.0387	−0.0093	0.0174	−0.0198	−0.0196	−0.0299
	51.00	40.81	53.34	−8.65	−3.04	1.60	56.21	46.17	55.85	−8.38	−1.96	2.18	−3.77	−2.89	−5.18

Note: This table presents the relationship between the pleasant and unpleasant return comovement estimates on the pleasant and unpleasant low and high return portfolios and their relationship with pleasant (P) and unpleasant hot (UH) and cold (UC) firms. In particular, each day, we sort firms into two groups using the previous week's retail order imbalance, and then for each group, we consider the firms exhibiting P, UH, and UC weather. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. We compute the value-weighted portfolio returns based on the previous month's market capitalization. The sample period is January 2010 to December 2018. Following Goetzmann et al. (2015), we redesign the return comovement analysis to accommodate our context (Green and Hwang, 2009; Kumar et al., 2013). Specifically, we obtain the daily pleasant and unpleasant return comovement coefficients by using a forward-looking 90-day window to estimate a similar rolling regression model as in Equation (10) for each of the pleasant and unpleasant low and high portfolios. The dependent variable is the firm's returns, and the independent variable includes the portfolio returns. Panel A reports the value-weighted pleasant and unpleasant comovement coefficients based on the previous month's market capitalization for pleasant and unpleasant firms, whereas Panel B reports the equal-weighted comovement coefficients. We also report the pleasant and unpleasant return comovement difference between pleasant and unpleasant firms, e.g., P−UH, P−UC, and UH−UC. The high−low comovement captures the difference between high and low return comovement coefficients. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.8: Order Imbalance Comovement Estimates on the Low and High Order Imbalances Portfolios and their Relationship with Pleasant and Unpleasant Firms

	P	UH	UC	P − UH	P − UC	UH − UC
Panel A						
Low imbalances comovement	0.6131	0.6077	0.7110	0.0178	−0.1094	−0.1401
	38.94	19.07	16.24	0.58	−2.60	−2.14
High imbalances comovement	0.5879	0.5727	0.7223	0.0327	−0.1442	−0.2029
	30.45	20.86	18.43	1.44	−4.05	−3.89
High − Low comovement	−0.0253	−0.0350	0.0113			
	−1.76	−1.13	0.37			
Panel B						
Low imbalances comovement	0.7523	0.7147	0.8234	0.0276	−0.0659	−0.1244
	82.90	30.59	22.40	1.21	−1.89	−2.37
High imbalances comovement	0.7961	0.8028	0.8765	−0.0149	−0.0736	−0.0850
	87.35	36.30	27.19	−0.68	−2.29	−1.75
High − Low comovement	0.0437	0.0881	0.0531			
	5.97	4.56	2.07			

Note: This table presents the relationship between the retail order imbalances comovement estimates on the low and high order imbalance portfolios and their relationship with pleasant (P) and unpleasant hot (UH), and cold (UC) firms. In particular, we sort firms into two groups each day using the previous week's retail order imbalance. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. We compute the equal-weighted order imbalance portfolios. The sample period is January 2010 to December 2018. Following Goetzmann et al. (2015), we redesign the return comovement analysis to accommodate our context (Green and Hwang, 2009; Kumar et al., 2013). Specifically, we obtain the daily order imbalance comovement coefficients by using a forward-looking 90-day window to estimate a similar rolling contemporaneous regression model as in Equation (11) for each low and high portfolio. The dependent variable is the firm's order imbalance, and the independent variable includes the retail order imbalance portfolio. Panel A reports the value-weighted order imbalance comovement coefficients based on the previous month's market capitalization for pleasant and unpleasant firms, whereas Panel B reports the equal-weighted comovement coefficients. We also report the pleasant and unpleasant imbalance comovement difference between pleasant and unpleasant firms, e.g., P−UH, P−UC, and UH−UC. The high−low comovement captures the difference between high and low order imbalance coefficients. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.

Appendix A.9: Pleasant and Unpleasant Order Imbalances Comovement Estimates on the Pleasant and Unpleasant Low, High and High − Low Order Imbalances Portfolios and their Relationship with P, UH, and UC Firms

	Low						High						High − Low comovement		
	P	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**	**P**	**UH**	**UC**	**P − UH**	**P − UC**	**UH − UC**	**P**	**UH**	**UC**
Panel A															
Pleasant comovement	0.5212	0.5171	0.5984	0.0018	−0.0875	−0.1020	0.4664	0.4299	0.5678	0.0450	−0.1050	−0.1786	−0.0548	−0.0872	−0.0306
	35.47	18.66	15.63	0.07	−2.46	−1.82	30.23	16.71	18.68	2.10	−3.63	−4.02	−4.90	−2.67	−1.14
Unpleasant hot comovement	0.1902	0.2381	0.2302	−0.0142	−0.0460	−0.0395	0.2065	0.2307	0.2877	0.0040	−0.0790	−0.1037	0.0146	−0.0077	0.0543
	14.15	14.05	7.91	−1.22	−1.82	−1.12	16.42	13.30	9.90	0.39	−3.24	−3.24	1.79	−0.58	2.28
Unpleasant cold comovement	0.2192	0.1670	0.2553	0.0219	−0.0177	−0.0437	0.2156	0.1871	0.2664	−0.0013	−0.0329	−0.0361	−0.0036	0.0201	0.0111
	14.26	7.70	13.81	1.51	−1.67	−2.04	12.89	8.55	13.93	−0.10	−3.29	−1.76	−0.42	1.28	0.86
Panel B															
Pleasant comovement	0.6377	0.5898	0.7167	0.0310	−0.0755	−0.1432	0.6522	0.6393	0.6787	−0.0023	−0.0210	−0.0333	0.0145	0.0496	−0.0380
	58.34	27.50	22.56	1.65	−2.59	−3.27	60.00	29.02	24.39	−0.12	−0.83	−0.81	2.14	2.80	−1.69
Unpleasant hot comovement	0.2332	0.2940	0.2780	−0.0231	−0.0409	−0.0317	0.2816	0.3474	0.3227	−0.0329	−0.0370	−0.0199	0.0455	0.0520	0.0408
	16.99	16.91	9.82	−2.35	−1.80	−1.01	20.91	20.56	11.65	−3.53	−1.78	−0.69	6.62	5.13	1.76
Unpleasant cold comovement	0.2699	0.2230	0.3280	−0.0021	−0.0339	−0.0379	0.2770	0.2221	0.3518	0.0061	−0.0479	−0.0631	0.0071	−0.0009	0.0238
	17.55	11.41	18.78	−0.20	−3.73	−2.22	16.40	9.68	18.89	0.49	−5.32	−3.48	1.38	−0.07	2.42

Note: This table presents the relationship between the pleasant and unpleasant order imbalance comovement estimates on the pleasant and unpleasant low and high order imbalance portfolios and their relationship with pleasant (P) and unpleasant hot (UH) and cold (UC) firms. In particular, each day, we sort firms into two groups using the previous week's retail order imbalance, and then for each group, we consider the firms exhibiting P, UH, and UC weather. We define pleasant firms as those *without* exposures to extreme temperatures, i.e., with days when the degree days above 30°C and below 0°C measures are zero. Unpleasant hot and cold firms are those *with* exposure to extreme temperatures, i.e., when degrees above 30°C and below 0°C measure, respectively, is different from zero. We compute the equal-weighted order imbalance portfolios. The sample period is January 2010 to December 2018. Following Goetzmann et al. (2015), we redesign the return comovement analysis to accommodate our context (Green and Hwang, 2009; Kumar et al., 2013). Specifically, we obtain the daily pleasant and unpleasant order imbalance comovement coefficients by using a forward-looking 30-day window to estimate a similar rolling regression model as in Equation (12) for each of the pleasant and unpleasant low and high portfolios. The dependent variable is the firm's order imbalances, and the independent variable includes the order imbalance portfolio. Panel A reports the value-weighted pleasant and unpleasant order imbalance comovement coefficients based on the previous month's market capitalization for pleasant and unpleasant firms, whereas Panel B reports the equal-weighted comovement coefficients. We also report the pleasant and unpleasant imbalance comovement difference between pleasant and unpleasant firms, e.g., P−UH, P−UC, and UH−UC. The high−low comovement captures the difference between high and low order imbalance coefficients. We adjust the standard errors using Newey-West (1987) with five lags to correct the serial correlation.