Mired in Losses: How the Disposition Effect Depresses Purchase Behavior

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Abstract

We document that retail investors who subscribe to stock recommendation services are less likely to purchase recommended stocks when most, or all, of their portfolio holdings are paper losses. We propose two mechanisms for this behavior: liquidity and attention. Liquidity: Investors often finance new purchases by selling existing positions. Investors who are reluctant to realize losses may forego new purchases if most of the stocks they can sell are paper losses. Consistent with this explanation, we find that investors buy fewer recommended stocks when they hold mostly losers and when they have less cash in their portfolio. Attention: We find that investors who receive new stock recommendations are less likely to log onto their brokerage app and read about these recommendations when they hold more paper losses. This leads to fewer purchases.

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1 Introduction

Suppose a retail trader wants to buy a particular stock. However, he does not have enough cash in his brokerage account nor does he have external funds that he is willing to transfer to his brokerage account. Furthermore, he is unwilling, or unable, to buy on margin. How can he pay for his desired purchase? He can sell one of the stocks he owns. Now, however, his appetite for the purchase depends upon his willingness, or his reluctance, to sell the stocks he owns. And, if he is like most investors, he will be reluctant to sell losing positions. So, if his portfolio is mostly paper losses, he may forego the desired purchase.

The disposition effect is the reluctance of investors to sell investments held for a loss and greater eagerness to sell those held for a profit (Statman and Shefrin 1985, Odean 1998, Kaustia 2004, Frazzini 2006). Studies of the disposition effect focus on the selling behavior of different asset classes[1] in different countries[2] as well as in laboratory settings[3]. Though the disposition effect has been documented for both individual and institutional investors[4], it tends to be strongest for less sophisticated investors.[5]

This paper differs from the prior literature by examining the effect of the disposition effect on the buying behavior of retail investors. For retail investors, purchasing a new stock is often financed by selling existing held positions from their portfolios.[6] For example, retail investors who are constantly faced with limited financial capital may need to sell held positions to finance new purchases.[7] Therefore, the phenomenon that affects investor selling decisions—e.g., the disposition effect—can affect investor buying decisions as well. Our main finding shows that the disposition effect leads not only to less selling activity by investors who hold losses, but also to less buying activity.

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[1] E.g., equities: Odean 1998; Grinblatt and Keloharju 2001, Frazzini 2006; employee stock options: Heath, Huddart, and Lang 1999; real estate: Genesove and Mayer 2001; futures: Locke and Mann 2005; cryptocurrencies: Schartzmann and Haslhofer 2023; equity options: Bergsma, Fodor, and Tedford 2020; Contracts for differences: Breitmayer, Hasso, and Pelster 2019.

[2] E.g., U.S.: Odean 1998; Finland: Grinblatt and Keloharju 2001; Israel: Shapira and Venezia 2001; Taiwan: Barber, Lee, Liu, and Odean 2007; United Kingdom: Richards, Rutterford and Fenton-O'Creevy 2017; China: Cai, Wang, and Bai 2018; Australia: Jackson 2003.

[3] E.g., Weber and Camerer 1998; Summers and Duxbury 2012; Frydman and Camerer 2016.

[4] Frazzini 2006; Cici 2012.

[5] Dhar and Zhu 2006; Cai, Wang, and Bai 2018.

[6] In our sample, conditional on days when investors purchase new stocks, the probability of selling a held stock is 62.2%.

[7] There are other but not-mutually-exclusive factors. For instance, investors who use mental accounts frame the investment decisions as replacing a held stock with a new one (Kumar and Lim 2008; Frydman, Hartzmark, and Solomon 2018). This paper does not aim to distinguish these different factors.

While this hypothesis can be tested in settings where both investors' purchases and holdings are observable as in a typical account-level dataset, the results are often confounded by the fact that the investment opportunities available to investors are not strictly controlled. For example, investors may not be aware of any investment opportunities due to limited attention and subsequently do not buy any stocks (Barber and Odean 2008). A general challenge to researchers is that against the backdrop that investors are constantly being inundated with stock information, any new information that may lead to a purchase does not necessarily catch the specific investors' attention. To clear this hurdle, we exploit a unique setting in which investors receive stock recommendations from recommenders to whom they subscribe.[8] Because investors are actively seeking such information via subscription and are automatically notified when a specific recommendation is issued, we can make sure that investors are certainly aware of the occurrence of such investment opportunities. Thus, we are able to closely examine investor decisions to follow these recommendations and relate them to their holding of gains and losses.

We first assess whether following solicited recommendations improves investors' performance. Recommenders provide both buy and subsequent sell recommendations for the same stocks. We find that a portfolio that follows these recommendations generates significant raw returns and positive alphas relative to various factor models. Further event-based analysis reveals that the performance of holding recommended stocks is modestly short-lived—peaking around 20 trading days after the recommendation date and reversing to negative returns within a year.[9] Although it is beyond the scope of this paper to establish why these recommenders successfully forecast short-term returns, we find suggestive evidence that this short-term return predictability partly originates from recommenders' ability to predict and front-run retail investor sentiment in the short run.

Our main hypothesis is that investors who hold relatively more losing positions and who have less cash are less likely to act on buy recommendations from the recommenders they follow. Our sample consists of 108 independent stock recommenders, 19,988 subscribed

[8] Hoechle, Ruenzi, Schaub, and Schmid (2017) examine the tendency of 558 investors to buy following advisor recommendations. They also do not examine the influence of investors' portfolio holdings on buying behavior.
[9] Recommenders are certainly aware of this return dynamic as the average recommendation period is around 22.7 days.

investors, and 12,367 recommendations issued by recommenders spanning from 2021 to 2023. We employ a fixed-effects model that includes investor-by-recommender and date fixed effects across all specifications. In essence, we examine whether time-series variation in the number of losses in the investor's portfolio affects the same investor's decision to follow recommendations from the same recommender to which he/she subscribed.

Our baseline results show that holding more paper-loss positions negatively impacts the likelihood of following recommendations. Holding all positions at a paper loss decreases the likelihood of buying the recommended stocks by 4.4 percentage points, which represents 52.4% reduction in the unconditional probability of following the buy recommendation.

We identify two potential channels our main findings that investors are less likely to buy recommended stocks when they hold more losses. The primary channel we propose is that investors often need to sell one stock to finance the purchase of another and they are reluctant to sell for a loss. Thus when they have fewer, or no, winners available to sell, they are less likely to buy a recommended stock. Our second proposed channel is that when investors hold more losses in their portfolio they are less likely to direct their attention to their portfolio or to trading opportunities. This "ostrich effect" (Karlsson, Loewenstein, and Seppi 2009; Sicherman, Loewenstein, Seppi, and Utkus 2016) prevents buy recommendations from even being considered much less executed.

To examine our first proposed channel, we exploit an exogenous shock to the availability of stocks investors can sell for a gain versus those they can sell for a loss. We examine the effect of a trading halt in a stock an investor holds on the decision to buy a recommended stock. Consistent with our hypothesis that investors avoid selling losing positions to fund new purchases but are willing to sell winners, we find that a trading halt in a stock held for a loss has virtually no effect on an investor's decision to buy a recommended stock, but a trading halt in a stock held for a gain reduces the probability that the investor will buy the recommended stock 4.6 percentage points (54.7% of the unconditional probability).

We further test our first proposed channel, by examining the willingness of investors to buy a recommended stock conditional on the amount of cash in their account. Investors with more cash may not need to sell positions to finance a purchase and will therefore be less

constrained by their reluctance to sell for a loss. We use two measures of cash: (cash holdings / total portfolio asset value) and (cash holdings / average position value). For both measures we find that increasing cash increases the probability that an investor will buy a recommended stock. Furthermore, the effect of more cash is greater when the ratio of losing positions to winning positions in the portfolio is higher.

We test our second channel by showing that investors with a higher ratio of losing positions in their portfolio, are less likely to view detailed information about buy recommendations in the brokerage's mobile application. When all of an investor's stocks are held at a loss, the investor is 28% less likely to view the detailed buy recommendation information. However conditional on viewing recommendation information, there is still a negative impact of holding losses on the likelihood of purchasing recommended stocks.

Prior literature shows that anticipated regret associated with the disposition effect can also affect purchases of stocks that are already or previously owned. Odean (1998) shows that investors are more likely to buy additional shares of stocks they already own if the price has gone down since purchase. He speculates that investors don't buy additional shares of stocks they own that have gone up in price because they anticipate that they will regret not having bought the additional shares at a lower price as part of their initial purchase. Strahilevitz, Odean, and Barber (2011) find that individual investors are more likely to repurchase a stock that they have previously sold if the price has dropped since the previous transaction. They attribute this behavior to the anticipation of regret if one repurchases at a higher price than the one at which one sold.

Our paper differs from these in that the stocks the investors in our sample are considering purchasing are not stocks they have previously purchased or sold. These investors are foregoing purchases so as not to experience the regret of selling other positions for a loss. They are even avoiding being reminded of their losing positions by logging into their accounts. Our findings demonstrate that the disposition effect exerts a much wider influence on investor behavior than previously recognized.

2 Stock recommenders

This section introduces stock recommenders and provides an overview of their operations.

2.1 Institutional background of stock recommenders

Stock recommenders are full-time employees hired by brokerage firms to provide stock recommendations to subscribed investors. These recommenders hold the legally required certification for securities investment advisory services issued by the China Securities Regulatory Commission (CSRC), which oversees and regulates their recommendations.[10] In our sample period from 2021 to 2023, our data includes 108 independent stock recommenders.[11] Prior to being employed as stock recommenders, recommenders typically have professional experience in the securities industry, including roles as analysts, asset management professionals, or financial journalists.

Under the CSRC's qualification regulations, a licensed recommender is permitted to work for only one institution at a time. As a result, these stock recommenders provide recommendations to subscribed investors exclusively through this brokerage firm. In addition, according to the *Interim Provisions on Securities Investment Advisory Services*, licensed recommenders are prohibited from issuing recommendations through public media such as television, radio, newspapers, or online platforms. Consequently, this setting allows us to sharply observe whether the investors of interest are receiving specific investing recommendations provided by their subscribed stock recommenders.

2.2 Subscription of recommendation services

Investors can receive stock recommendations issued by a stock recommender after subscribing to the recommender. Investors can decide whether to subscribe after examining the recommender's information displayed on the brokerage platform.

Each stock recommender has its own homepage on the brokerage platform, which

[10] Under Article 225 of the *Criminal Law of the People's Republic of China* (2023 Amendment), engaging in securities investment consulting activities without the required CSRC official license—such as providing stock recommendations to the general public for profit—constitutes the crime of illegal business operations and is subject to criminal liability.

[11] In practice, some stock recommenders voluntarily form advisory teams and issue recommendations under a team name. Because advisory teams and individual recommenders do not differ in how recommendations are issued, subscribed to, or evaluated, we do not distinguish between them in our analysis.

provides information on outstanding stock recommendations, past recommendation history, past performance, and other related information. Prior to subscribing to a recommender, investors can view only the performance section to evaluate the recommender. Access to the remaining sections is granted only after subscription. Figure 1 provides an example of the performance page from the homepage of one stock recommender. More details about the homepage can be found in Appendix A.1.1. All substantive information is available exclusively on the recommender's homepage. While subscribers may receive brief notifications through other channels (discussed in detail in the next subsection), these notifications only signal that a recommendation has been issued.

INSERT <Figure 1> HERE

At the time of subscription, investors choose between a fixed-fee scheme and a transaction-based pricing scheme. All fees, commission rates, and applicable conditions are set by the recommender and disclosed in the subscription contract. In our sample, most subscriptions (96.43%) are charged under the transaction-based pricing scheme. Under this scheme, investors typically pay a commission that ranges from 0.1% to 0.3% of the purchase amount. More details about the pricing scheme can be found in Appendix A.1.2. After the subscription becomes effective, investors retain the right to terminate the contract at any time at their own discretion. Investors are allowed to subscribe to up to three stock recommenders simultaneously.

2.3 Issuance of recommendations

We describe how stock recommenders issue recommendations on the brokerage platform. Stock recommendations include both buy and sell recommendations. When a stock recommender believes that a particular stock is worth purchasing at a given point in time, the recommender issues a buy recommendation and adds the stock to the pool of currently recommended stocks, which is shown in her homepage. At the time of the buy recommendation, the platform requires the recommender to specify a stop-loss order for the stock.

A sell recommendation can only be issued for currently recommended stocks. Sell recommendations occur either when the recommender believes that it is optimal to exit the position or when the stock price declines and triggers the pre-specified stop-loss order. Upon issuing a sell recommendation, the stock is removed from the recommender's stock pool. When evaluating recommenders' performance, both types of sell recommendations are considered.

For each buy or sell recommendation, recommenders are required to provide a textual rationale for the recommendation. In particular, when a sell recommendation is triggered by the stop-loss order, the stated rationale explicitly indicates that the stock price has reached the stop-loss threshold. This information is available exclusively on the recommender's homepage in the brokerage's platform.

Recommenders can issue buy and sell recommendations only during trading hours and only for A-share stocks or exchange-traded funds (ETFs) that are not suspended from trading. For each buy or sell recommendation, the platform automatically assigns a transaction price based on the prevailing best available price in the order book at the time the recommendation is issued. This price serves as the recommended buy or sell price.

The platform produces and publishes several performance metrics based on the sell price and buy price of the recommended stocks (an example displayed in Figure 1). When the sell price exceeds the buy price, a recommended stock is classified as a winner stock and an investor who follows the recommender's buy and sell signals should earn a positive holding-period return. Both the average holding-period return of recommended stocks and the proportions of winner stocks are shown to potential investors on the brokerage platform.

2.4 Recommendation notifications

A key feature of our setting is that the recommendation information is exclusive to the brokerage platform for subscribed investors. We provide the details of how such information is delivered to investors.

Whenever the recommender issues a buy or sell recommendation, the subscribed investors will receive recommendation notifications. These notifications are delivered via

SMS, WeChat (the Chinese version of "WhatsApp"), and smartphone push notifications. The use of multiple notification channels ensures that investors are made aware of the recommendations. Consequently, if investors do not follow a recommendation, it reflects a deliberate choice rather than simply missing the information.

Panel A and Panel B of Figure 2 present examples of these notifications delivered via SMS and WeChat, respectively. These brief notifications provide a concise overview of the recommendation, including the recommender's name, the recommended stock, and the current stock price.

INSERT <Figure 2> HERE

After viewing these brief notifications, investors may choose to access more detailed information in the brokerage's mobile application either through the message center or through the recommender's homepage. Panel C and Panel D of Figure 2 present examples of recommendation information displayed in the message center and on the recommender's homepage, respectively. In addition to the information provided in the brief notifications, information on recommendation rationales is provided. Investors can also further browse the stock information in the brokerage's mobile application.

Leveraging high-frequency browsing data from the brokerage's mobile application, we are able to precisely identify whether an investor viewed the detailed recommendation information within the app on the day the recommendation was issued. If investors do not read the detailed information, it may indicate a lack of interest in purchasing new stocks. We use this data to help identify the potential mechanisms of our findings.

3 Data and Summary Statistics

In this section, we describe the data and present summary statistics. Section 3.1 introduces the proprietary data used in this study, Section 3.2 summarizes the key variables used in our analysis, and Section 3.3 describes investors and stock recommenders in our sample.

3.1 Sample and data sources

The data were provided by a listed brokerage company in China on an anonymous, secure, and restricted-access basis. We accessed the data and conducted the analysis on an internal and secured server. We use a comprehensive dataset and summarize these data in five aspects. First, we use the data regarding stock recommenders and investors' subscriptions to recommenders. The subscription data span from 2021 to 2023 and include information on investors, their subscribed recommenders, subscription pricing, and subscription periods.

We use 19,988 investors in our sample who subscribed to stock recommenders and followed at least one recommendation after the subscription.[12] Our sample includes 108 independent stock recommenders. For each recommender, the recommendation data provide details on the recommended stocks, buy and sell recommendation dates, the rationale behind each recommendation, and whether the sell recommendation was triggered by a self-imposed stop-loss order.

The second and third datasets pertain to investors' trades and holdings, respectively, that occurred in investors' general accounts.[13] Both datasets cover the period from 2018 to 2023. The trade data provide detailed information on each transaction, including the stock (or ETF) code, trade timestamp (to the millisecond), trade volume (in shares), transaction value (excluding commission), and commission. The holdings data, which include cash items, are recorded on a daily basis and include information on the stock (or ETF) code, number of shares held, market value, and holding cost, which is used to calculate paper profits.

Complementing these datasets, we also have access to investors' demographic information and high-frequency in-app browsing data from the brokerage's mobile application. The browsing data record each individual click, including both page views and specific on-page interactions, together with time stamps accurate to the second.

For other variables used in the analysis, such as stock characteristics, we rely on external

[12] We define a following event if the investor purchases the recommended stock within ten trading days of the recommendation date.

[13] Besides a general account, 3,328 of the 19,988 investors in our sample hold a margin account. The portfolios of these accounts are managed separately on the brokerage's mobile application.

public datasets, including the China Stock Market & Accounting Research (CSMAR) database.

We construct our main sample at the investor-recommender-stock-date-level where investor *i* receives a buy recommendation of stock *j* from his/her subscribed recommender *l* on date *t*. Utilizing data from 19,988 investors, 108 recommenders, and 12,367 stock recommendations, we generate 1,796,840 observations from 2021 to 2023. Then, we apply a few filters. First, we ensure that the recommended stock is not already held in the investor's portfolio on the day prior to the buy recommendation. Second, since investors may subscribe to up to three stock recommenders simultaneously, we ensure that the stock under consideration is being recommended by only one of their subscribed recommenders within ten trading days following the recommendation. These filters slightly reduce the number of sample observations from 1,796,840 to 1,732,428.

3.2 Variables

3.2.1 Following recommendation

Our key dependent variable, denoted by *Follow recommendation*, captures whether an investor follows the stock recommender's buy recommendation. We allow for the possibility that investors may take time to process the recommendation and make a purchase decision. Accordingly, we construct a dummy variable, *Follow recommendation* (*10 days*), which equals one if the investor purchases the recommended stock within ten trading days following the recommendation, and zero otherwise. As an alternative specification, we also consider *Follow recommendation* (*Same day*), which equals one if the investor purchases the recommended stock on the recommendation day, and zero otherwise.

Throughout the paper, purchases of recommended stocks refer exclusively to transactions executed through the investor's general brokerage account. Margin trading and cash trading are conducted through two separate accounts. We find that within the sample of investors who own margin accounts, only 0.7% of the recommendations were followed via purchases through margin accounts within ten days of the recommendations.

3.2.2 Paper-loss positions

The key explanatory variable in our analysis, denoted by *Paper loss ratio*, captures the extent to which an investor holds losing positions in his/her portfolio. Specifically, it measures the fraction of an investor's positions whose holding market value falls below their holding cost as of the previous day of the buy recommendation date. As an alternative specification, we also include a dummy variable, *All paper losses*, which equals one if all of the investor's positions are held at a loss, and zero otherwise.

A position is classified as a paper-loss position if its current market value is strictly lower than its holding cost.[14] Otherwise the position is classified as paper-gain. Importantly, both holding cost and holding market values are not constructed by us but are directly calculated, recorded, and provided by the brokerage. These values correspond to those displayed on investors' stock holdings pages in the brokerage mobile application.

INSERT <Figure 3> HERE

Figure 3 displays an example of such a stock holdings page in the brokerage mobile application, which consists of portfolio information and position-wise information. On the page, blue numbers indicate losses, while red numbers indicate gains, allowing investors to visually and immediately distinguish losing positions from winning ones.

3.2.3 Other variables

Details on the definitions of other variables are reported in Appendix Table A1, which includes Panel A on investor characteristics, Panel B on stock recommender characteristics, and Panel C on variables used in the regressions.

3.3 Summary statistics

In this section, we first present summary statistics for investor characteristics, stock recommender characteristics, and then show the performance of stock recommenders.

[14] Holding cost is measured as cumulative sum of purchase principal minus cumulative sum of selling proceedings, which is a formula now widely used across almost all brokerages in China.

3.3.1 Investor characteristics

Table 1 provides a comprehensive summary of portfolio holdings, trading activity, and performance characteristics for 19,988 retail investors who subscribed to recommendation services and followed at least one stock recommendation during the sample period from 2021 through 2023. In Panel A, we report the trading behavior of subscribed investors. The average total asset in the general account, including cash, stocks, and ETFs, is 588,391.07 CNY (equivalent to 83,578.28 USD), but the median is 227,796.43 CNY (equivalent to 32,357.45 USD), which implies that the distribution is skewed to the right. Regarding stock holdings, on average, investors hold approximately 9.80 stocks with an average holding period of 38.66 days. Investors on average make 30.39 trades per month. The average trade size is 32,122.87 CNY (equivalent to 4,549.98 USD) and annualized portfolio turnover is notably high at 1730.06%. These profiles suggest that these investors trade actively and frequently. Subscribed investors in our sample exhibit a pronounced disposition effect, as measured by a PGR/PLR ratio with an average value of 12.71 and an average PGR–PLR difference of 0.15.[15]

INSERT <Table 1> HERE

Panel B examines the attributes of stocks purchased by subscribed investors. The average logged market capitalization is 16.48, suggesting that investors primarily purchase medium-sized to large-cap stocks. The book-to-market ratio averages 0.66, indicating a preference for moderately valued stocks.[16] Momentum measures over the past year reveal an average return of 32.64%, implying that investors purchased stocks that outperformed in the last 12 months.

Panel C reports the performance metrics of subscribed investors. The average annualized portfolio return is -6.89%, suggesting overall underperformance during the sample period.[17]

[15] Following Odean (1998), the proportion of gains realized (PGR) is defined as the number of stocks sold at a gain divided by the total number of stocks with realized and unrealized gains, while the proportion of losses realized (PLR) is defined as the number of stocks sold at a loss divided by the total number of stocks with realized and unrealized losses.

[16] Over the period from 2021 to 2023, the median and 75th percentile of the log market capitalization of all A-share listed firms are 15.23 and 16.06, respectively. The corresponding median and 75th percentile of the book-to-market ratio are 0.59 and 0.98.

[17] Over the period from 2021 to 2023, the Shanghai Composite Index declined from 3,473.07 at the beginning of 2021 to 2,974.93 at the end of 2023. This corresponds to a cumulative return of -14.34% and an annualized average return of

However, percentile values show significant variation, with top-performing investors (the 90th percentile) achieving positive returns of 2.33%. Investors' short-term returns following both purchase and sale transactions are negative. On average, stocks purchased (sold) by investors generate returns of -0.60% (-0.45%) over the subsequent five trading days, and -1.81% (-1.57%) over the subsequent 20 trading days. These results indicate that the overall underperformance mostly comes from poor purchase decisions.

Panel D provides demographic insights into the subscribed investors. Approximately 40% of the investors are female, while 72% have attained a college-level education. The average age of investors is 49.11 years. Investors have an average account age of 10.26 years.[18]

3.3.2 Stock recommender characteristics

We begin by presenting summary statistics at the recommender level. Table 2 summarizes descriptive statistics of trading activity and performance characteristics for 108 stock recommenders during the sample period from 2021 to 2023. Variables are calculated at the recommender level and summarized across all recommenders.

INSERT <Table 2> HERE

Panel A reports recommenders' recommendation frequency and duration. On average, stock recommenders issued 4.96 stock recommendations per month with an average recommendation period of 22.71 days.[19] A related concern is whether stock recommendations cluster on a small set of stocks across recommenders. Table IA2 reports the frequency with which multiple recommenders are recommending the same stocks on a given day. Out of an average 545.04 stocks under recommendation on a given day, 15.66% are being recommended by multiple recommenders. The average number of recommenders behind a recommended stock is 1.28. This evidence suggests that, while some overlap exists, the majority of recommendations are not concentrated on a small set of stocks.

approximately -5.06%.

[18] Table IA1 summarizes the trading activity and performance characteristics of non-subscribing investors over the same sample period. The results show some differences between non-subscribers and subscribers. Non-subscribers exhibit lower asset holdings and a smaller number of held stocks. Their average holding period is significantly longer than that of subscribers, suggesting a relatively passive investment style.

[19] Recommendation period is determined by number of days between buy and sell recommendation dates.

Panel B examines the attributes of stocks recommended. The average logged market capitalization of recommended stocks is 16.41 and the book-to-market ratio averages 0.70. The recommended stocks have an average past 12-month return of 21.59%. These attributes largely overlap with those of stocks purchased by subscribed investors, suggesting that investors prefer stock recommenders with similar styles.

Panel C reports the performance of recommenders based on the metrics used by the brokerage and published to investors. The winner ratio, defined as the percentage of recommendations yielding positive raw returns, averages 70.25%. The average recommender achieves an average holding return following the recommendation of 1.14%. In contrast to the negative average portfolio returns earned by retail investors, these results suggest that, at least ex-post, stock recommenders' recommendations may improve retail investors' performance.

3.3.3 Stock recommender performance

We present further analysis on the performance of recommenders' recommendation signals. Two types of analyses are performed. First, we construct a portfolio based on all recommenders' buy recommendation signals and the corresponding sell signals. A stock is added to the portfolio each time it is recommended by a different stock recommender. The stock is removed from the portfolio the day after a sell recommendation is issued. An equal-weighted portfolio is formed and rebalanced daily. Specifically, the weight of stock s in the aggregate portfolio on day t can be defined as

$$w_{s,t} = \frac{n_{s,t}}{\sum_s n_{s,t}}, \quad (1)$$

where $n_{s,t}$ denotes the number of recommenders who are recommending stock s on day t. Then, the daily holding return of the portfolio R_t is defined as

$$R_t = \sum_s w_{s,t} r_{s,t}, \quad (2)$$

where $r_{s,t}$ denotes the return of stock s on day t.

We then evaluate the performance of this aggregate portfolio using various factor models, including the Fama–French three-factor model (FF3), the Carhart four-factor model (FFC4),

and the Fama–French five-factor model (FF5). Panel A of Table 3 presents the portfolio-based analysis. The annualized portfolio raw return and corresponding alphas are all positive and statistically significant, ranging from 8.21% to 8.34%.

INSERT <Table 3> HERE

Second, we adopt an event-based approach by calculating the average cumulative returns following recommendations over various holding periods (5, 10, 20, 60 and 250 trading days). The measures are calculated at the recommender-investor-recommendation level, and t-statistics are clustered at the investor level.[20] Returns are measured using four metrics: raw return, DGTW-abnormal return, net market return, and return relative to equal-weighted investor portfolio.

Panel B of Table 3 presents this event-based analysis. Short-term horizons of 5 and 20 trading days exhibit significant positive returns across all metrics, with raw returns peaking at 1.375% for the 20-trading days horizon. This finding is consistent with the fact that the average recommendation period lasts 22.71 trading days, suggesting that recommenders understand the return dynamics of their recommendations. However, performance over intermediate to long-term horizons of 60 and 250 trading days declines sharply, with raw returns turning negative (-3.859%) at the 250 trading days horizon. This pattern suggests that recommenders primarily adopt short-term trading strategies, focusing on stocks with near-term price runup rather than potential those that are expected to perform better over longer horizons.

Nonetheless, these buy recommendations consistently outperform investor portfolios for up to a year. These findings suggest that even if investors did not strictly follow recommenders' signals to buy and sell stocks, following these recommendations stocks by and large improved investors' portfolio performance during the sample period.

While it is not the focus of this paper, one may wonder how stock recommenders' strategies generate short-term positive returns. We find evidence that links this

[20] The significance levels of all coefficients remain unchanged when we cluster standard errors at the recommender and recommender-date levels.

outperformance to recommenders' ability to predict the sentiment of retail investors. Prior studies show that retail order imbalance is positively related to short-term future stock returns (Boehmer, Jones, Zhang, and Zhang 2021). Given the high participation of retail investors in the Chinese A-share market (Jones, Shi, Zhang, and Zhang 2025), predicting retail sentiment can produce profitable short-term trading strategies. Table IA3 shows that recommendation signals are positively and significantly associated with small-sized order imbalances across different forward-looking windows (5, 10 and 20 trading days). These findings suggest that the return predictability of these recommendations may partly stem from their ability to predict and front-run retail investor sentiment in the short run.

4 Holding paper-loss positions and following recommendation

In this section, we test our main hypothesis by examining the relationship between investors holding paper-loss positions and their likelihood of following stock recommendations. Section 4.1 presents the baseline regression results. Section 4.2 explores heterogeneity in the main effects. Section 4.3 conducts a series of robustness tests.

4.1 Baseline regression

We test our main hypotheses by relating investors' following decisions to their holding of paper-loss positions in their portfolios. We employ a fixed-effects model that includes investor-by-recommender fixed effects across all specifications. In essence, we examine whether time-series variation within an investor's portfolio in terms of paper-loss positions affects the investor's decision to follow recommendations from the same subscribed recommender. We also include date fixed effects to absorb aggregate market conditions on the recommendation day that may influence investors' willingness to purchase stocks and follow recommendations. For all regressions, we cluster standard errors at the investor level, as an individual investor's decisions are unlikely to be independent over time.[21] These repeated decisions by the same investor are therefore correlated rather than independent.

Then, we estimate the following OLS regression:

[21] The results remain statistically significant when we choose to cluster at investor and date levels or at recommender and date levels.

$$Follow\ recommendation\ (10\ days)_{i,j,t,l} = \alpha + \beta Paper\ loss\ ratio_{i,t} + \gamma Controls + \lambda_{i,j} + \mu_t + \varepsilon_{i,j,t,l}, \quad (3)$$

where *Follow recommendation* (*10 days*) is an indicator, which equals one if investor i purchases stock l recommended by recommender j within ten trading days following the recommendation day t, and zero otherwise. *Paper loss ratio* is defined as the fraction of paper-loss positions among an investor's total positions as of the previous day relative to the recommendation. *All paper losses* is a dummy variable, which equals one if all positions are held at a loss, and zero otherwise. $\lambda_{i,j}$ and μ_t denote investor-recommender fixed effects and date fixed effects, respectively.

We include two sets of control variables in some specifications. The first set captures the variables that are likely to be correlated with our main independent variables: investors' portfolio-level unrealized paper profit (*Unrealized paper profit*) and past portfolio performance measured over the various intervals ([-5, -1], [-20, -6], [-250, -21] trading days relative to the recommendation day). These two measures are negatively correlated with *Paper loss ratio*. The second set controls for characteristics of the recommended stocks, including firm size (*Ln*(*Size*)), book-to-market ratio (*Book-to-market*), one-year momentum (*Momentum_1y*), an indicator for lottery-type stocks (*Lottery type stock*), the stock's social media attention (*Stock's social media posts*), market beta (*Beta*), and whether the recommended stock has also received a buy recommendation from any stock analysts (*Analyst recommendation*). Detailed variable definitions are available in Table A1.

In Table 4, we report summary statistics for the variables used in the main regression analyses. At the investor–recommender–stock–date level, the unconditional probability that an investor follows a buy recommendation within ten trading days is 8.4%, while the probability of purchasing the recommended stock on the recommendation day is 6.3%; thus the majority of purchases following a recommendation take place on the recommendation day.

INSERT <Table 4> HERE

Investors in our sample on average have more paper-loss positions than paper-gain positions: on average, 71.7% of an investor's positions are held at a loss, and in 22.9% of the observations, all positions in the investor's portfolio are paper losses. Turning to the characteristics of recommended stocks, the average (log) market capitalization, book-to-market ratio, and past 12-month return are 15.967, 0.597, and 34.2%, respectively. 8.8% of recommended stocks are lottery stocks (see Table A1, Panel C for definition). On average, the recommended stocks receive 1.396 times as many social media posts as the market-wide average over the ten trading days preceding the recommendation, suggesting that the recommended stocks receive above-average investor attention.

INSERT <Table 5> HERE

Table 5 reports the estimation results under different specifications. Columns (1) and (2) include only the key explanatory variables—*Paper loss ratio* and *All paper losses*, respectively, without any fixed effects. The estimated coefficients on *Paper loss ratio* (*All paper losses*) are -0.067 (-0.060) and are statistically significant at the 1% level. Columns (3) and (4) further include investor-recommender and date fixed effects.[22] The coefficient on *Paper loss ratio* (*All paper losses*) is -0.076 (-0.047) and is statistically significant at the 1% level. Columns (5) and (6) further include additional control variables. The magnitude of the estimated coefficients on *Paper loss ratio* (*All paper losses*) slightly decreases after adding controls, from -0.076 (-0.047) to -0.071 (-0.044), while statistically significant at the 1% level.

These results support our main hypothesis that holding more losses negatively affects the likelihood of following recommendations. Based on the estimates in Column (6) of Table 5, given the same investor, having all positions held at a loss makes the investor 7.1 percentage points less likely to follow a recommendation, compared with the base case, which corresponds to 52.4% (0.044 / 0.084) of the unconditional following probability. These findings indicate that the anticipated regret that arises from selling losing positions makes investors reluctant to realize losses and in turn less likely to act on new investment

[22] The specification that uses investor fixed effect generates almost the same estimation results.

opportunities.

Regarding the control variables, the results in Columns (5) and (6) of Table 5 show that portfolio-wise unrealized profits shows a similar effect on investors' following decisions but the magnitude is smaller than that of our main measures that count the number of losing positions.[23] This is in line with our argument that investors frame their portfolio decisions as changing each position individually rather than adjusting them systematically. Moreover, investors' recent portfolio performance is positively associated with the likelihood of following recommendations. Specifically, the coefficient on *Portfolio return* [-5, -1] is positive and statistically significant at the 1% level, whereas the coefficient on *Portfolio return* [-250, -21] is statistically insignificant. This pattern suggests that investors who have earned higher returns in the recent past are more inclined to purchase recommended stocks, while longer-term portfolio performance does not exert a similar influence.

Turning to the characteristics of recommended stocks, the estimated coefficients on *Ln* (*Size*), *Book-to-market*, and *Momentum_1y* are all positive and significant at the 1% level. These patterns are consistent with previously documented investor preferences on stock characteristics. Finally, the coefficients on *Lottery type stock* and *Stock's social media posts* are also positive and statistically significant, suggesting that investors exhibit a preference for stocks with lottery-like features and heightened market attention.

4.2 Heterogeneity analysis

Next, we examine heterogeneity in the relationship between holding losses and the likelihood of following recommendations across investors with different trading and portfolio characteristics.

To avoid confounding effects arising after investors subscribe to recommenders, we classify investors based on their pre-subscription characteristics measured over the 12 months prior to their first subscription. Specifically, we sort investors into low, medium, and high groups according to (i) their disposition effect (measured by PGR / PLR), (ii)

[23] Based on Column (5) of Table 5, a one–standard-deviation increase in the *Paper loss ratio* makes the investor 1.8 percentage points less likely to follow a recommendation. In contrast, a one–standard-deviation increase in *Unrealized paper profit* makes the investor 0.25 percentage points more likely to follow a recommendation.

portfolio size, and (iii) trading frequency (average number of trades per month). We then estimate subsample regressions separately for each group to assess how the effect of holding paper-loss positions varies across these investor characteristics. All regressions in this section include the two sets of control variables described in Section 4.1, as well as investor-recommender and date fixed effects. Table 6 reports the results of these sub-sample regressions.

INSERT <Table 6> HERE

First, we expect that investors who exhibit stronger disposition effect — those who are more reluctant to sell losers than winners, are even less likely to sell losers in order to follow recommendations. When investors are grouped by the extent of disposition effect, we observe a clear monotonic pattern. The estimated coefficients on *Paper loss ratio* are -0.035, -0.080, and -0.151 for investors in the low-, middle-, and high-disposition-effect groups, respectively, all statistically significant at the 1% level. A Wald test strongly rejects the equality of coefficients across groups (*Wald* statistic = 238.12, $p < 0.01$). These results confirm our conjecture.

Regarding portfolio size, the estimated coefficient on *Paper loss ratio* equals -0.090 for investors with small portfolios, -0.084 for those with medium-sized portfolios, and -0.052 for investors with large portfolios. All coefficients are statistically significant at the 1% level. Differences across the three groups are statistically significant, with a *Wald* statistic of 19.89 ($p < 0.01$). One possibility is that investors with larger portfolios have more options to sell at a gain for a given *paper loss ratio* and are therefore less constrained.

For trading frequency, the estimated coefficients of *Paper loss ratio* are -0.051, -0.061, and -0.097 for investors in the low, middle, and high trading-frequency groups, respectively, suggesting the pronounced effect for frequent traders. All coefficients are statistically significant at the 1% level. A Wald test strongly rejects the equality of coefficients across the three groups (*Wald* = 1149.22, $p < 0.01$), indicating substantial heterogeneity.

In conclusion, the results show that the negative impact of holding paper-loss positions

on following recommendations affects investors across large and small disposition effect, portfolio size, and trading frequency but is more pronounced for investors with a higher disposition effect, smaller portfolios, and higher trading frequency.

4.3 Robustness checks

In this subsection, we conduct robustness checks for the baseline regressions examining the relationship between investors holding losses and their likelihood of following recommenders' recommendations. Table IA4 reports a battery of results from various alternative specifications and subsamples. All regressions in this section include the full set of control variables used in Column (5) of Table 5, as well as investor–recommender and date fixed effects.

4.3.1 Alternative dependent variable

We replace the dependent variable with an alternative measure. Columns (1)-(2) use *Follow recommendation* (*Same day*), which equals one if the investor purchases the recommended stock on the same day the recommendation is issued. The estimated coefficients on *Paper loss ratio* (*All paper losses*) are -0.060 (-0.040) and remain statistically significant at the 1% level. In terms of economic significance, within the same investor, holding all positions at a paper loss reduces the probability of purchasing the recommended stock on the recommendation day by 4.0 percentage points, representing 63.4% of the unconditional same-day following probability.

4.3.2 Additional sample variations

We conduct a series of additional sample variations. In all regressions in this section, the dependent variable is *Follow recommendation* (*10 days*). First, to rule out the possibility that an investor's decision to follow a recommendation is influenced by recommendations from other subscribed recommenders, we exclude all observations in which the investor subscribed to more than one recommender at the time the recommendation was issued. Under this restriction, the estimated coefficient on *Paper loss ratio* remains negative and statistically significant at the 1% level, with an estimated coefficient of -0.065, as reported in Column (3) of Table IA4.

Second, to address the concern that investors may not fully trust a recommender immediately after the subscription, we exclude all recommendation observations within the first six months after an investor subscribes to a recommender. Column (3) of Table IA4 reports the estimation results for this restricted sample and show that our baseline results are robust to excluding the early subscription period.

Third, for investors who are more skilled than stock recommenders, it may not be rational to follow the recommender's advice. To rule out this possibility, we exclude investors whose portfolio realized returns exceed the realized returns from following recommendations during the sample period. Column (5) of Table IA4 reports the corresponding results. The estimated coefficient on the *Paper loss ratio* remains negative and statistically significant at the 1% level, with a coefficient of -0.075.

Finally, to examine whether our baseline results are driven disproportionately by the two most-followed recommenders—each of whom has more than 5,000 subscribers—we exclude all observations associated with these two recommenders. As shown in Column (6) of Table IA4, the estimated coefficient on *Paper loss ratio* remains negative and statistically significant at the 1% level, with a coefficient of -0.089. This indicates that our results are not driven solely by the popular recommenders and also hold for recommenders with smaller subscriber bases.

4.3.3 Alternative independent variables: Piecewise function

To examine how the likelihood of following recommendations varies with the intensity of number of paper losses, we estimate a piecewise specification of *Paper loss ratio*. Specifically, we partition *Paper loss ratio* into five indicator variables corresponding to intervals of [0,0.2), [0.2,0.4), [0.4,0.6), [0.6,0.8), [0.8,1]. Column (7) of Table IA4 reports the estimated coefficients for these five intervals. The coefficients are -0.037 for [0,0.2), -0.060 for [0.2,0.4), -0.120 for [0.4,0.6), -0.138 or [0.6,0.8), -0.195 for [0.8,1]. Except for the lowest interval [0,0.2) which is statistically insignificant, all remaining coefficients are significant at the 1% level.

The results indicate that the negative effect of holding losses on the likelihood of

following recommendations intensifies monotonically as *Paper loss ratio* increases. This pattern is highly consistent with our hypothesis. When there are only a small fraction of losing positions in the investor's portfolio, they can easily choose among the remaining large fraction of winning positions for sale so as to purchase the recommended stocks. In contrast, when there are significant fractions of losing positions, investors are forced into selling losing positions and in turn become more sensitive to the changes in number of losing positions.

5 Alternative hypotheses

In this section, we discuss potential alternative hypotheses that affect our interpretation of the results. Section 5.1 deals with rational learning. Section 5.2 deals with changes in risk preferences. Section 5.3 exploits trading halts as an exogenous shock to provide further causal evidence.

5.1 Rational learning

In our main results, we document a negative relationship between holding paper-loss positions and the likelihood of following recommenders' buy recommendations, which we interpret as evidence of the influence of the disposition effect. However, an alternative explanation based on rational learning may also account for this pattern. Specifically, investors who hold a larger fraction of losing positions may infer that following new recommendations is less likely to improve their portfolio performance—e.g., because of bad market timing. If holding more losing positions is associated with lower expected gains from following recommendations, it would be rational for investors to refrain from purchasing newly recommended stocks. Under this interpretation, investors' reduced propensity to follow recommendations reflects rational updating from losses rather than a behavioral reluctance to realize losses.

Table IA5 examines the relationship between holding paper-loss positions and the return of recommended stocks relative to the investor's equal-weighted portfolio, assuming various holding horizons of 5, 10, 20, 60, and 250 trading days. The results demonstrate a positive and significant relationship between the paper loss measure and relative returns

across all holding periods. These findings suggest that the potential portfolio improvement from following recommendations is *greater* when investors hold more paper-loss positions. Had investors learnt from their position profits, a rational response would contrast with the behavior we observe; therefore, this evidence rules out a rational learning story based on observing their position profits.

5.2 Changes in risk preferences

Another alternative hypothesis that may drive our baseline results is investors' changes in risk preferences. Specifically, unrealized profits may affect investors' risk preferences, which in turn affects their purchase decisions (Imas 2016). Such theories often suggest that risk preferences respond more to changes in the amount of unrealized profits than to changes in our measure that counts the number of different positions. In contrast, in our main tests that include both *Paper loss ratio* and *Unrealized paper profit*, the magnitude of the former is significantly greater than that of the latter. This supports our hypothesis over this risk-preference hypothesis.

Moreover, the risk-preference hypothesis also suggests that the changed risk preferences alter investors' preferences for certain characteristics (e.g., beta and lottery-like property). We directly test this conjecture by interacting the *Paper loss ratio* with characteristics of the recommended stocks in our baseline regressions. As shown in Table IA6, none of these interaction terms are statistically significant, indicating that investors' preferences over stock characteristics do not vary systematically with holding paper-loss positions. This evidence does not support changes in stock preferences as an alternative explanation for our baseline findings.

5.3 Trading halts as exogenous shocks

To further address these concerns, we utilize trading halt events as negative shocks that reduce the number of positions available for sale for the purpose of purchasing new stocks. Meanwhile, having a position halted from trading—which does not change its exact paper profits—is unlikely to directly influence investors' risk preferences or their beliefs about other stocks. Table 7 reports the effect of trading halts on investors' decisions to follow

stock recommendations. All regressions in this section include the full set of control variables used in Column (5) of Table 5, as well as investor–recommender and date fixed effects.

INSERT <Table 7> HERE

In Column (1), we include a dummy variable, *Halt*, which equals one if the investor holds at least one stock that is subject to a trading halt at the time of the recommendation. The estimated coefficient on *Halt* is -0.046 and is statistically significant at the 1% level. This result shows that investors holding stocks under trading halts are less likely to follow recommendations as they are deprived of the option to sell the halted stocks.

Column (2) further decomposes trading halt events into two interaction terms: *Halt* × *Paper gain* (an indicator for trading halts affecting paper-gain positions), and *Halt* × *Paper loss* (an indicator for trading halts affecting paper-loss positions). The estimated coefficient on *Halt* × *Paper gain* is -0.054 (t =-5.13), which is statistically significant at the 1% level. In contrast, the coefficient on *Halt* × *Paper loss* is -0.009 (t = -0.80) and is not statistically significant. We find that halts of paper-gain positions—but not paper-loss positions—significantly reduce the likelihood of following recommendations. This finding is consistent with our argument that, due to the disposition effect, investors are more willing to sell paper-gain positions than paper-loss positions in order to finance new investments. Therefore, losing the availability to sell paper-gain positions is more impactful than losing the availability to sell paper-loss positions.

Furthermore, Column (3) further includes these two separate variables and their interactions with *Paper loss ratio*. The estimated coefficient on *Halt* × *Paper gain* × *Paper loss ratio* is -0.027 (t = -4.78), which is statistically significant at the 1% level. In contrast, the coefficient on *Halt* × *Paper loss* × *Paper loss ratio* is -0.047 (t = -1.04) and is not statistically significant. The results indicate that the effect of halts of paper-gain positions is more pronounced when investors already hold more paper-loss positions. This is because having fewer existing paper-gain positions makes losing one due to a trading halt more impactful. Overall, these tests involving halted positions provide causal support for our main findings that holding more paper-loss positions reduces investors' propensity to buy

new stocks due to their reluctance to realize losses.

6 Mechanism analysis

In this section, we explore two potential mechanisms underlying our main findings: financial constraints in Section 6.1 and attention-driven ostrich behavior in Section 6.2.

6.1 Financial constraints

The simultaneous consideration of buying and selling activity partly arises from limited financial capital available to retail investors; investors need to sell a held position in order to finance the purchase of a new stock. We therefore hypothesize that investors holding more cash are more likely to make independent purchase decisions and are consequently less influenced by the disposition effect related to existing positions. To test this conjecture, we construct three measures of cash holdings as inverse proxies for financial constraints.[24] *Cash ratio1* is defined as the ratio of cash holdings to total portfolio value. *Cash ratio2* is defined as the ratio of cash holdings to the investor's average position size over the past 250 trading days. In addition, we construct a dummy variable, I(*Cash ratio2>1*), which equals one if the investor's current cash holdings are sufficient to finance at least one additional average-sized position.

INSERT <Table 8> HERE

Table 8 examines the role of financial constraints in the relationship between holding paper-loss positions and following recommendations (*Follow recommendation* (*10 days*)). Columns (1)-(3) include *Cash ratio1, Cash ratio2,* I(*Cash ratio2>1*) and their interactions with *Paper loss ratio* (*All paper losses*) in Panel A (Panel B).

Across all specifications, the coefficients on the various measures of cash holdings are positive and statistically significant at the 1% level, indicating that a higher cash ratio unconditionally increases the following likelihood as investors are less financially constrained. Moreover, their interactions with the *Paper loss ratio* (or *All paper losses*) are

[24] In the Chinese A-share market, a T+1 trading rule is in place. While selling proceeds cannot be withdrawn on the same day of sale, they can be used for purchase of new shares. More details on the trading rules, including the treatment of cash from stock sales, are provided in Appendix A.2.

also positive and statistically significant at the 1% level. The results show that a higher level of cash holdings significantly mitigates the negative impact of holding paper-loss positions on following recommendations. Based on Column (3) of Panel A, the estimated coefficient on I (*Cash ratio2>1*) × *Paper loss ratio* is 0.014, while the coefficient on *Paper loss ratio* alone is -0.076. This indicates that, on average, when an investor's current cash holdings are sufficient to finance at least one additional position, the negative effect of holding paper-loss positions on the likelihood of following a recommendation is mitigated by approximately 18.4% (0.014 / 0.076).

Overall, these results suggest that investors with greater liquidity are less constrained by the necessity of selling positions and are more likely to act on recommendations without thinking about their existing positions.

6.2 Attention-driven ostrich effect

The second channel involves the attention-driven ostrich effect, by which contemplating portfolio changes will naturally direct investors' attention to the fact that they are holding paper-loss positions, which induces negative feelings (Karlsson, Loewenstein, and Seppi 2009; Sicherman, Loewenstein, Seppi, and Utkus 2016). Anticipated negative feelings reduce investors' willingness to make portfolio decisions and discourage them from acquiring information about new investment opportunities. We examine this channel by testing the relationship between investors' holdings of paper-loss positions and their likelihood of viewing detailed recommendation information in the brokerage's mobile application.

Based on the browsing data, we measure whether investors made specific clicks in the brokerage's mobile application that exclusively leads to detailed information about the recommendations. Appendix A.3 provides a detailed illustrative example of how investors' browsing behavior is recorded in the data. We construct an indicator variable, *View message*, which equals one if the investor viewed the detailed recommendation message in the brokerage's mobile application on the recommendation day. As reported in Table 4, the sample probability of viewing detailed recommendation information is 32.2%. Moreover,

on the recommendation day, the following probability conditional on viewing is 16.20%,[25] whereas the following probability conditional on not viewing is 1.60%, suggesting that the action of viewing messages indicates the investor's initial interest in buying new stocks and demand for the relevant information.

INSERT <Table 9> HERE

Table 9 investigates how holding paper-loss positions influences investors' incentive to acquire information about the recommended stocks. Panel A (Panel B) reports results based on *Paper loss ratio* (*All paper losses*). The dependent variable in Column (1) is *View message*. Based on the results in Column (1) of Panel A (Panel B), the coefficients on the *Paper loss ratio* (*All paper losses*) are -0.140 (-0.090) and are statistically significant at the 1% level. The results indicate that holding paper-loss positions significantly reduces the likelihood of viewing recommendation information for trading. The coefficient indicates that holding all positions at a paper loss causes investors to be less likely to view the recommendation information by 9.0 percentage points, which represents 28.0% of the average viewing probability.

Further analysis indicates that this attention-driven ostrich effect might explain up to approximately one-third (0.09 × 16.2% / 0.04=36.5%) of the overall negative effect of holding losses on the likelihood of following recommendations. This is estimated by multiplying the estimated effect of holding losses on viewing recommendation information (-0.090; Column (2) of Panel B in Table 9) by the probability of following a recommendation conditional on viewing (16.2%), and then dividing this product by the unconditional effect of holding all positions at a loss on following recommendations (-0.040; Column (2) of Table IA4). (Note, however, that an investor who knows he has few or no positions that can be sold at a gain and does not want to sell at a loss, might choose not to read about the recommendation. Thus, whether the ostrich effect leads to fewer purchase recommendations being considered or the awareness that one is not going to buy leads to

[25] The unconditional following probability is 6.30% when we only focus on purchasing the recommended stock on the same day as the recommendation.

fewer views of purchase recommendations is not certain.)

Finally, we show that the negative relationship between holding losing positions and following recommendations still exists if we account for investors' attention. Columns (2) of Panel A and B re-examine the relationship between the *Paper loss ratio* (*All paper losses*) and same-day following decisions *conditional* on investors having viewed the detailed recommendation messages on the same day. The estimated coefficient on *Paper loss ratio* (*All paper losses*) is -0.015 (-0.055), which remains negative and statistically significant at 1% level.

7 Generalization: Buying new stocks

We have thus far shown that holding more paper-loss positions reduces investors' likelihood of purchasing recommended stocks due to the disposition effect. In this section, we extend the analysis by examining whether this effect generalizes to investors' decisions to purchase any new stocks (i.e., not recommended), rather than being confined to recommender-issued buy recommendations.

We explore the relationship between holding paper-loss positions and the likelihood of purchasing new stocks on any given day. The analysis is based on a 10% random sample of investors who did not subscribe to stock recommenders during the sample period.[26] We conduct regressions at the investor–date level. The dependent variable is *Buy*, which equals one if the investor purchases a stock that was not previously held on that day, and zero otherwise. The key independent variables are the *Paper loss ratio* and *All paper losses*. The regressions include the set of investor performance controls, as well as investor and date fixed effects. Standard errors are clustered at the investor level.

Table IA7 reports the regression results. The estimated coefficient on the *Paper loss ratio* (*All paper losses*) is -0.130 (-0.115), which is statistically significant at the 1% level. In terms of economic magnitude, given the same investor, having all positions held at a loss makes the investor 11.5 percentage points less likely to purchase a new stock, compared with the base case. The results show that holding more paper-loss positions significantly

[26] Similar results if we use the sample of subscribed investors.

decreases the likelihood of investors purchasing new stocks. This suggests that investors with unrealized losses are less likely to initiate new investments.

8 Conclusion

Retail investors with stock purchase ideas often face liquidity constraints. They may not have enough cash in their brokerage account or other available funds to finance the purchase. In such cases, they may choose to sell an existing position to pay for the new purchase. Investors with a disposition effect—a tendency to hold onto paper losses and realize paper gains—will tend to have more paper losses in their portfolios and may decide to forego an otherwise appealing purchase.

We examine the trades of retail investors who subscribe to and are notified about stock recommendations. In sample, these recommendations outperform the investors' portfolios. We find that investors who hold proportionately more portfolio losses are less likely to log onto their brokerage app to read about the recommendations. And, conditional on reading about the recommendations, they are less likely to buy the recommended stocks. Not buying when holding losses is more pronounced for investors who have less cash in their accounts. Trading halts in stocks held for a gain, reduce new purchases—buy preventing sales for a gain, but trading halts in stocks held for a loss have little effect.

The disposition effect is a selling phenomenon. We show that it also affects buying. Investors who are reluctant to realize losers, will also be reluctant to make new purchases.

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Figure 1. Recommender's homepage

This figure presents the recommender's homepage as observed by investors prior to subscription. The left panel shows the original interface of the brokerage mobile application, while the right panel presents a translated version. The page reports several key performance metrics. Holding-period return is defined as (sell price - buy price) / buy price and highest return is defined as (the highest price during the holding period - buy price) / buy price. The winner ratio is calculated as the number of winner stocks (including both past winner stocks and currently held winner stocks) divided by the total number of recommendations, including current and past recommendations. The absolute winner ratio is defined as the fraction of past recommendations that yield a holding-period return greater than 2%, where we classify such stocks as absolute winner stocks.



Fengkou No.1
(recommender name)

Recommended stocks	History	Performance (current page)	Strategy notes

Winner ratio (past 3 months)	Winner ratio (up to now)	Absolute winner ratio
62.5%	**86.9%**	**71.4%**
Average holding-period return	# recommended stocks (per month)	# winner stocks /# historical recommendations
4.41%	**6.56 times**	**72/84 times**

Recommendation Samples (78 stocks)

	Sell/Buy date	Sell/Buy price	Holding-period /Highest return
Jinlei gufen (stock code: 300443)	08-29 06-09	27.01 19.78	36.55% 46.81%
Rationale for buy recommendation: available after subscription			
Rationale for sell recommendation: available after subscription			
Jinghua xincai (stock code: 603683)	03-04 02-20	14.22 10.34	37.52% 39.07%
Rationale for buy recommendation: available after subscription			
Rationale for sell recommendation: available after subscription			
Weike keji (stock code: 301196)	02-20 02-13	46.85 35.44	32.20% 32.28%

No subscription fee, an add on commission of 0.3% | **Subscribe Now**

Figure 2. Recommendation notifications

This figure illustrates recommendation information delivered to investors at different stages. Panels A and B present recommendation notifications, delivered via SMS and WeChat, respectively. Panels C and D present detailed recommendation information displayed within the broker's mobile application, including the message center and the recommender's homepage, respectively. In each panel, the left and right subpanel shows the original interface as received by investors and an English translation version.



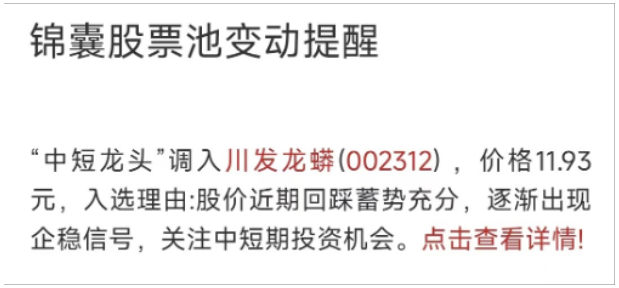
[Broker name]: Dear client, your subscribed recommender "Short-term leader" recommends to buy stock "**Chuanfa longmang**"(stock code:002312). The current price is at 11.93 CNY. You can check the recommendation rationale in [Broker name] APP. Investing involves risk; investors should exercise discretion when making investment decisions. (Broker website link)

Panel A: Recommendation notification via SMS



[Broker name] **Recommendation notification**	
Recommender name:	Short-term leader
Recommended stock:	**Chuanfa longmang** (stock code: 002312)
Recommendation type:	Buy
Current stock price:	11.93 CNY
Recommendation rationale:	The recommendation is based on the recommender's analysis. Please refer to the [Broker name] app for the exact information.

Panel B: Recommendation notification via WeChat



Notification of changes to the recommendation stock pool
[Broker name]
“Short-term leader” recommends to buy stock “Chuanfa longmang”(stock code:002312). The current stock price is at 11.93 CNY. Recommendation rationale: After a recent pullback, the stock is showing early signs of stabilization, presenting short-term opportunities. Click for more information.

Panel C: Detailed information available in the brokerage’s mobile application message center



2025-12-02

10:22:08	Buy	**Chuanfa longmang** (stock code:002312)	11.93

Rationale for buy recommendation:After a recent pullback, the stock is showing early signs of stabilization, presenting short-term opportunities.

One-click trade

Panel D: Detailed information on recommender’s homepage

Figure 3. Stock holdings page in the brokerage's mobile application

This figure presents the stock holdings page viewed by investors in the brokerage's mobile application. The left panel shows the original interface of the brokerage's mobile application, while the right panel presents a translated version. For each position, paper profit (CNY) equals the difference between the current price and the holding cost per share multiplied by the number of shares held, while paper profit (%) is the corresponding return relative to the holding cost. Gains and losses based on the sign of paper profit are displayed in different colors (red for gains and blue for losses). Daily profit change (CNY) is measured as the change in market value from the previous trading day, net of intraday trading expenditures and proceeds, and daily profit change (%) is scaled by the market value at the end of the previous trading day.



Holdings

Name: (holder's name) ID:(account number)

Buy	Sell	Order cancellation	Holdings (current page)	More

CNY (general) account

(Portfolio information)

Total asset value	Paper profit (CNY)	Daily profit change (CNY)
7846.47	-156.63	+176.00
Market value of stocks	Available cash for trade	Available cash for withdrawal
7678.00	168.47	168.47

(Position information)

Juren wangluo (stock code: 002558)

Daily profit change: 145.00 3.40%

Market value: 4414.00	Position percentage: 56.25%
Paper profit (CNY): 445.36	Paper profit (%) : 11.22%
Current price: 44.140	Holding cost per share : 39.686
# shares held: 100	# shares available for sale: 100

Shiji huatong (stock code: 002602)

Daily profit change: 6.00 0.36%

Market value: 1680.00	Position percentage: 21.41%
Paper profit (CNY): -346.05	Paper profit (%) : -17.08%
Current price: 16.800	Holding cost per share : 20.261
# shares held: 100	# shares available for sale: 100

Wanmei shijie (stock code: 002604)

Daily profit change: 25.00 1.60%

Market value: 1584.00	Position percentage: 20.19%
Paper profit (CNY): -255.94	Paper profit (%) : -13.90%
Current price: 15.840	Holding cost per share : 18.399
# shares held: 100	# shares available for sale: 100

Table 1. Trading, portfolio, and performance characteristics of subscribed investors (2021–2023)

This table reports portfolio holdings, trading activity, and performance characteristics of 19,988 investors who subscribed to recommendation services and made at least one purchase following the recommendation during the sample period 2021–2023. Variables are first measured at the investor level and averaged across investors. Table A1, Panel A provides detailed definitions of the variables.

	Mean	SD	p25	p50	p75
Panel A: Stock trading					
Total asset value (*CNY*)	588,391.07	1,849,018.63	100,494.46	227,796.43	526,058.32
# Stocks held	9.80	9.98	4.39	7.17	11.81
# ETFs held	0.76	2.61	0.00	0.03	0.64
Holding period (*days*)	38.66	39.29	8.69	21.68	55.95
# Trades (*per month*)	30.39	55.86	6.444	14.509	33.472
Trade size (*CNY*)	32,122.87	76,743.88	9,129.47	17,035.84	33,578.02
Annualized turnover (%)	1730.06	1736.06	379.29	970.10	2562.10
Disposition effect (*PGR/PLR*)	12.71	40.00	2.39	4.81	10.64
Disposition effect (*PGR-PLR*)	0.15	0.13	0.05	0.12	0.23
Panel B: Stock characteristics of purchased stocks					
Ln (*Size*)	16.48	0.71	15.99	16.41	16.89
Book-to-market ratio	0.66	0.51	0.49	0.59	0.73
Momemtum_1y (%)	32.64	33.00	10.91	26.81	47.22
Panel C: Performance					
Annualized portfolio return (%)	-6.89	5.96	-12.64	-8.84	-0.66
Post buy return % (*week*)	-0.60	1.22	-1.19	-0.54	0.03
Post buy return % (*month*)	-1.81	2.72	-3.25	-1.75	-0.32
Post sell return. % (*week*)	-0.45	1.44	-1.11	-0.47	0.15
Post sell return % (*month*)	-1.57	3.02	-3.14	-1.66	-0.13
Panel D: Demographic information					
Female	0.40	0.49	.	.	.
College education	0.72	0.45	.	.	.
Age (*years*)	49.11	11.39	41.00	49.00	57.00
Account experience (*years*)	10.26	7.57	4.00	8.00	15.00

Table 2. Trading and performance characteristics of stock recommenders

This table reports descriptive statistics of trading activity and performance characteristics of 108 stock recommenders during the sample period 2021–2023.Variables are first measured at the recommender level and averaged across recommenders. "Weighted mean" is the mean of the variable weighted by number of followers. Table A1, Panel B provides detailed definitions of the variables.

	Mean	Weighted mean	SD	p25	p50	p75
# Subscribers	254	·	1050.79	41	87	209
Panel A: Stock recommendation						
Recommendation period (*days*)	22.71	16.00	11.03	14.63	16.43	26.11
# Recommended stocks (*per month*)	4.96	9.15	1.84	3.57	3.93	6.02
Panel B: Characteristics of recommended stocks						
Ln (*Size*)	16.41	16.38	0.84	15.81	16.36	17.00
Book-to-market ratio	0.70	0.61	0.36	0.53	0.63	0.78
Momentum_1y (%)	21.59	30.95	19.07	8.36	18.78	32.46
Panel C: Performance						
Winner ratio (%)	70.25	73.27	6.14	64.71	67.79	74.57
Holding-period return (%)	1.14	1.34	1.00	0.28	0.75	1.84

Table 3. Performance of recommenders' stock recommendations

This table evaluates the performance of stock recommendations issued by stock recommenders. Panel A presents the portfolio-based analysis. Stocks are included in the portfolio on the trading day following a recommendation and held until the corresponding sell signal is issued. The weight of a stock in the aggregate portfolio is determined by the number of times it appears across the 108 recommenders' portfolios (i.e., its total count across recommenders) divided by the total number of stock holdings across all recommenders on that day, counting duplicates. The portfolio is formed and rebalanced daily. The table reports annualized raw returns and alphas (in percentages) based on various factor models. Panel B reports the overall performance of recommenders' recommendation signals by computing the average returns following recommendations over various forward-looking windows. Returns are measured using four metrics: raw return, DGTW-adjusted abnormal return, net-market return, and return relative to investors' equal-weighted portfolios. All measures are computed at the investor-recommender-recommendation level, and standard errors are clustered at the investor level. *t*-statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Portfolio-based analysis					
	Raw return	FF3	FFC4	FF5	
Aggregate portfolio	10.846***	8.338***	8.221***	8.640***	
	(4.47)	(5.11)	(4.96)	(5.39)	
Panel B: Signal-based analysis					
Holding period	[1, 5]	[1, 10]	[1, 20]	[1, 60]	[1, 250]
Raw return	0.882***	1.072***	1.375***	0.643	-3.859***
	(6.68)	(10.46)	(13.52)	(1.37)	(-7.57)
Abnormal DGTW return	0.692***	0.877***	1.043***	0.424	-3.071***
	(10.62)	(4.76)	(7.83)	(1.51)	(-4.84)
Net market return	0.963***	1.205***	1.863***	2.141***	-0.896*
	(6.75)	(10.87)	(13.79)	(4.13)	(-1.67)
Return relative to investor portfolio	1.653***	2.656***	3.758***	4.895***	7.041***
	(12.46)	(17.73)	(14.57)	(12.62)	(16.53)

Table 4. Descriptive statistics of variables used in regressions

This table reports descriptive statistics of variables used in the main regression analysis. Table A1, Panel C provides detailed definitions of these variables.

	N	Mean	SD	p25	p50	p75
Follow recommendation (*10 days*)	1,732,428	0.084	0.277	.	.	.
Follow recommendation (*Same day*)	1,732,428	0.063	0.243	.	.	.
Paper loss ratio	1,732,428	0.717	0.256	0.556	0.750	0.938
All paper losses	1,732,428	0.229	0.420	.	.	.
Unrealized paper profit	1,732,428	-0.131	0.123	-0.224	-0.104	-0.022
Portfolio return [-5, -1] (%)	1,732,428	-0.069	0.157	-0.122	-0.021	0.027
Portfolio return [-20, -6] (%)	1,732,428	-0.209	0.330	-0.322	-0.072	0.016
Portfolio return [-250, -21] (%)	1,732,428	-5.241	6.342	-7.583	-2.246	-0.581
Ln (*Size*)	1,732,428	15.967	1.078	15.170	15.940	16.716
Book-to-market ratio	1,732,428	0.597	1.190	0.251	0.414	0.648
Momentum_1y	1,732,428	0.342	0.675	-0.103	0.191	0.634
Lottery type stock	1,732,428	0.088	0.284	.	.	.
Stock's social media posts	1,732,428	1.396	2.029	0.401	0.761	1.433
Beta	1,732,428	1.092	0.671	0.798	1.082	1.411
Analyst recommendation	1,732,428	0.052	0.222	.	.	.
Halt	1,732,428	0.006	0.077	.	.	.
Cash ratio1	1,732,428	0.167	0.217	0.005	0.066	0.259
Cash ratio2	1,732,428	1.571	2.046	0.031	0.576	2.371
I (*Cash ratio2* > 1)	1,732,428	0.412	0.492	.	.	.
View message	1,732,428	0.322	0.467	.	.	.
Follow recommendation (*Same day*) | *iew Message* = 1	557,518	0.162	0.369	.	.	.

Table 5. Baseline regression: Paper loss and following recommendation

This table reports baseline regression results examining the relationship between holding paper-loss positions and investors' likelihood of follow recommenders' recommendations. The dependent variable is a dummy variable *Follow recommendation* (*10 days*), which equals one if the investor buys the recommended stock within 10 trading days following the recommendation. *Paper loss ratio* is the number of paper-loss positions, divided by the total number of positions in an investor's portfolio. *All paper losses* is a dummy variable, which equals to one if all of an investor's positions are at a loss, and zero otherwise. Table A1, Panel C provides detailed definitions of all other variables. All regressions include investor and date fixed effects. Standard errors are clustered at the investor level. t-statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Follow recommendation (*10 days*)					
	(1)	(2)	(3)	(4)	(5)	(6)
Paper loss ratio	-0.067***		-0.076***		-0.071***	
	(-23.55)		(-42.37)		(-38.44)	
All paper losses		-0.060***		-0.047***		-0.044***
		(-46.10)		(-50.29)		(-46.88)
Unrealized paper profit					0.020***	0.042***
					(4.23)	(9.09)
Portfolio return [-5, -1]					0.006***	0.007***
					(7.72)	(8.56)
Portfolio return [-20, -6]					0.000	0.001**
					(1.31)	(2.04)
Portfolio return [-250, -21]					0.000	0.000
					(0.20)	(0.37)
Ln (*Size*)					0.001***	0.001***
					(2.92)	(2.97)
Book-to-market ratio					0.006***	0.006***
					(19.53)	(19.47)
Momentum_1y					0.005***	0.005***
					(10.77)	(11.06)
Lottery type stock					0.022***	0.022***
					(25.09)	(25.09)
Stock's social media posts					0.003***	0.003***
					(24.88)	(25.15)
Beta					0.003***	0.003***
					(10.03)	(10.11)
Analyst recommendation					-0.009	-0.009
					(-1.62)	(-1.47)
Investor-recommender FE	N	N	Y	Y	Y	Y

Date FE	N	N	Y	Y	Y	Y
Observations	1,732,428	1,732,428	1,732,428	1,732,428	1,732,428	1,732,428
R-squared	0.004	0.008	0.222	0.223	0.226	0.227

Table 6. Heterogeneity analysis

This table reports subsample regressions examining heterogeneity in the relationship between *Paper loss ratio* and the likelihood of investors following recommendations (*Follow recommendation* (*10 days*)). Investors are divided into terciles (Low, Middle, and High) based on their characteristics during the 12 months prior to subscribing to the recommendation service. The sorting characteristics are disposition effect (*PGR*/*PLR*), portfolio size (*Total asset value* (*CNY*)), and trading frequency (*# Trades* (*per month*)). The differences in coefficient estimates between the high and low groups, along with the Wald chi-square test for their equality, are reported in the last two rows. All regressions include the same control variables, investor and date fixed effects as specified in Column (5) of Table 5. Standard errors are clustered at the investor level. *t*-statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Sorting variables	Disposition effect			Portfolio size			Trading frequency		
	Low	Middle	High	Low	Middle	High	Low	Middle	High
Paper loss ratio	-0.035***	-0.080***	-0.151***	-0.090***	-0.084***	-0.052***	-0.051***	-0.061***	-0.097***
	(-16.82)	(-25.35)	(-30.39)	(-22.17)	(-26.34)	(-21.29)	(-26.58)	(-25.05)	(-21.24)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Investor-recommender FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	576,894	577,169	578,365	577,353	577,414	577,661	576,625	577,066	578,737
R-squared	0.223	0.250	0.249	0.230	0.256	0.232	0.218	0.280	0.280
Diff.(High minus Low)		-0.116***			0.038***			-0.046***	
Wald Chi-square test		238.12***			19.89			1149.22	

Table 7. Trading halts as exogenous shocks

This table investigates the effect of trading halts on investors' decisions to follow stock recommendations. Events in which investors' held positions are halted from trading serve as exogenous shocks to the availability of those positions for sale. Based on the specification in Column (4) of Table 5, Column (1) adds a dummy variable, *Halt*, indicating whether the investor holds any stocks under trading halt at the time of recommendation. Column (2) decomposes trading halt events into *Halt* × *Paper gain* (trading halts of any paper-gain positions) and *Halt* × *Paper loss* (trading halts of any paper-loss positions). Column (3) further includes these two separate variables and their interactions with *Paper loss ratio*. All regressions include the same control variables and fixed effects as Column (5) of Table 5, and standard errors are clustered at the investor level. *t*-statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Follow recommendation (*10 days*)		
	(1)	(2)	(3)
Paper loss ratio	-0.071***	-0.071***	-0.071***
	(-38.43)	(-38.42)	(-38.42)
Halt	-0.046***		
	(-4.15)		
Halt × *Paper gain*		-0.054***	-0.051***
		(-4.97)	(-4.48)
Halt ×*Paper gain* × *Paper loss ratio*			-0.027***
			(-6.77)
Halt × *Paper loss*		-0.009	0.031
		(-0.79)	(0.67)
Halt × *Paper loss* × *Paper loss ratio*			-0.047
			(-0.92)
Controls	Y	Y	Y
Investor-recommender FE	Y	Y	Y
Date FE	Y	Y	Y
Observations	1,732,428	1,732,428	1,732,428
R-squared	0.226	0.226	0.226

Table 8. Mechanism analysis: Financial constraints

This table examines the role of financial constraints in shaping the relationship between holding paper-loss positions and investors' likelihood of following a recommendation (*Follow recommendation* (*10 days*)). Columns (1)–(3) introduce alternative inverse measures of investor financial constraints based on cash holdings and their interactions with *Paper loss ratio* in Panel A and with *All paper losses* in Panel B. *Cash ratio1* is defined as the portfolio share of cash holdings. *Cash ratio2* is the ratio of cash holdings to the investor's average position size over the past 250 trading days. I (*Cash ratio2 > 1*) is a *dummy* variable equal to one if the investor's cash holdings exceed the average position size over the past 250 trading days, and zero otherwise. All regressions include the same set of control variables, investor and date fixed effects. Standard errors are clustered at the investor level. *t*-statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Independent variable: *Paper loss ratio*

	Follow recommendation (*10 days*)		
	(1)	(2)	(3)
Paper loss ratio	-0.072***	-0.075***	-0.076***
	(-34.10)	(-30.13)	(-31.43)
Cash ratio1	0.055***		
	(13.23)		
Cash ratio1 × *Paper loss ratio*	0.040***		
	(7.60)		
Cash ratio2		0.014***	
		(20.43)	
Cash ratio2 × *Paper loss ratio*		0.030***	
		(4.25)	
I (*Cash ratio2>1*)			0.050***
			(21.65)
I (*Cash ratio2>1*) × *Paper loss ratio*			0.014***
			(4.91)
Controls	Y	Y	Y
Investor-recommender FE	Y	Y	Y
Date FE	Y	Y	Y
Observations	1,732,428	1,732,428	1,732,428
R-squared	0.228	0.229	0.229

Panel B: Independent variable: *All paper losses*

	Follow recommendation (*10 days*)		
	(1)	(2)	(3)
All paper losses	-0.052***	-0.052***	-0.053***
	(-36.42)	(36.12)	(-36.60)

Cash ratio1	0.093***		
	(35.07)		
Cash ratio1 × All paper losses	0.024***		
	(7.38)		
Cash ratio2		0.012***	
		(34.54)	
Cash ratio2 × All paper losses		0.020***	
		(5.71)	
I (*Cash ratio2 > 1*)			0.042***
			(38.45)
I (*Cash ratio2 > 1*) × *All paper losses*			0.011***
			(7.53)
Controls	Y	Y	Y
Investor-recommender FE	Y	Y	Y
Date FE	Y	Y	Y
Observations	1,732,428	1,732,428	1,732,428
R-squared	0.229	0.230	0.230

Table 9. Mechanism analysis: Financial attention

This table reports regression results examining how holding paper-loss positions influences investors' attention to recommendation information and their subsequent following decisions conditional on attention. The dependent variable in Column (1) is *View message*, which equals one if the investor viewed the recommendation messages in his/her app on the recommendation day, and zero otherwise. The dependent variable in Column (2) is *Follow recommendation* (*Same day*), which equals one if the investor buys the recommended stock on the same day, and zero otherwise. The regression sample includes only observations where investors viewed the recommendation messages on the recommendation days. Panel A reports results based on *Paper loss ratio*, while Panels B replaces *Paper loss ratio* with *All paper losses*, respectively. All regressions include relevant control variables, investor and date fixed effects, and standard errors are clustered at the investor level.

Panel A: Independent variable: *Paper loss ratio*

	View message	*Follow recommendation* (*Same day*)
	(1)	(2)
		conditional on viewing messages
Paper loss ratio	-0.140***	-0.076***
	(-39.13)	(-22.30)
Controls	Y	Y
Investor-recommender FE	Y	Y
Date FE	Y	Y
Observations	1,732,428	557,518
R-squared	0.443	0.356

Panel B: Independent variable: *All paper losses*

	View message	*Follow recommendation* (*Same day*)
	(1)	(2)
		conditional on viewing messages
All paper losses	-0.090***	-0.055***
	(-49.37)	(-30.53)
Controls	Y	Y
Investor-recommender FE	Y	Y
Date FE	Y	Y
Observations	1,732,428	557,518
R-squared	0.440	0.355

Appendix

A.1 Further details on recommender services

A.1.1 Recommender's homepage

The homepage consists of four main pages: outstanding stock recommendations, history, performance, and strategy notes. The outstanding stock recommendations page lists the stocks currently held in the recommender's stock pool. The history page records all past buy and sell recommendations issued by the recommender. The performance page summarizes key metrics such as trading frequency and the performance of recommended stocks. Finally, the strategy notes page contains the recommender's periodic reflections and summaries of their overall investment approach over a given period.

The performance page of a stock recommender typically contains three modules (an example displayed in Figure 1). The top module summarizes the recommender's overall performance and trading frequency. It reports key metrics, including the winner ratio (the fraction of recommended stocks classified as winner stocks), the average holding-period return, and the number of stocks recommended per month. The middle module presents a selection of past recommendation examples chosen by the recommender. Specifically, this module displays representative recommendations, including the stock name, the dates of the buy and sell recommendations, the corresponding buy price and sell price, as well as the holding-period return and the maximum return achieved during the holding period for each completed recommendation. The bottom module provides an overview of the subscription pricing.

After reviewing these three modules, investors can decide whether to subscribe to the recommender. If they choose to subscribe, they can click the "subscribe now" button located at the bottom right of the page. The platform then presents a detailed electronic subscription contract specifying the pricing terms. The subscription becomes effective once the investor reviews and signs the contract.

A.1.2 Pricing schemes

When subscribing to a recommender, investors choose between two broad pricing schemes: a fixed-fee plan or a commission-based plan. Under the fixed-fee scheme, investors pay an upfront fee for a fixed subscription period, typically 3 months (3.57% of investor–recommender observations).

Alternatively, investors may opt for a transaction-based pricing scheme, under which no upfront fee is charged at the time of subscription. Instead, an additional commission is imposed on transactions of the recommended stocks under certain predefined conditions after the subscription. Under the commission-based scheme, each recommender offers one pre-specified commission structure, and investors who choose this option are charged according to that structure. Across recommenders, we observe two types of commission-based pricing arrangements. First, a universal add-on commission of 10–15 basis points is charged on all trades executed during the subscription period, regardless of whether the

trades are recommended by the recommender (12.68%). Second, a performance-based commission of 30 basis points is charged only on recommended stocks and only when the investor sells the stock at a gain (83.75%). The specific criteria are listed below:

Case 1. Sale of the recommended stocks following recommendation
- When the recommender recommends selling the stock,
- The sell realizes a profit greater than 2%, and
- The investor sells the recommended stock within 20 days following the sell recommendation.

Case 2. Sale initiated by investors before recommendation
-When the investor sells a stock that was previously recommended by the recommender before the recommender issues a sell recommendation,
- Regardless of whether the transaction results in a gain or a loss.

Case 3. Sale after subscription termination
- When the investor sells a stock within 30 days after terminating the subscription,
- Regardless of whether the transaction results in a profit or a loss.

A.2 The T+1 trading rule in the Chinese stock market

The Chinese A-share market operates under a T+1 trading system, under which investors are not allowed to sell shares on the same trading day they purchased. According to the relevant regulations issued by the China Securities Regulatory Commission (CSRC) and the stock exchanges, stocks purchased on day t can only be sold starting from trading day $t+1$.

Importantly, while shares purchased on day t cannot be sold on the same day, the cash proceeds from selling previously held shares on day t can be used immediately to purchase other stocks on the same day, although such cash cannot be withdrawn until the next trading day. This institutional feature implies that investors' ability to finance new stock purchases on a given day depends on whether they can liquidate existing positions. As a result, when investors are reluctant or unable to sell their current holdings—particularly losing positions—their effective liquidity for financing new purchases may be constrained, even though trading itself is permitted.

A.3 Browsing data

The browsing data record each individual click, including both page views and specific on-page interactions, together with time stamps accurate to the second. Panels A and B of Figure A1 present two examples of an investor's in-application browsing behavior on November 7, 2023, in which the investor browses detailed recommendation information through the recommender's homepage and the message center following a buy recommendation for *Jiuzhou yaoye* issued at 9:57:06 by the recommender *Short-term Leader*. The data allow us to trace the investor's sequence of actions for each click. Taking Panel A as an example, the investor first visits the recommender's homepage at 9:58:09. After viewing the detailed recommendation message, the investor then opens the stock detail page for *Jiuzhou yaoye* (stock code: 603456) at 9:59:04, subsequently switches the price chart (K-line) to the monthly view at 10:00:20, and finally clicks the "Buy" button at

10:00:59 on the stock detail page to place an order for the recommended stock. Therefore, the variable *View message* for this case is set at one as the investor browses the recommender's homepage after receiving the recommendation notification.

There are several caveats to using this data. First, investors' browsing activity outside the mobile application (e.g., on computers) is not recorded. Second, some browsing activity may not be successfully captured for mechanical reasons. For example, users may restrict the application from collecting data for privacy reasons.

Figure A1. Two examples of in-application browsing data

This figure illustrates all browsing- and click-level actions of an individual investor within the brokerage's mobile application. Panel A shows an example of the investor's browsing path through the recommender's homepage between 9:58:09 and 10:00:59, and Panel B shows an example through the message center between 10:00:03 and 10:03:07, both for accessing detailed recommendation information on November 7, 2023.

Click time	Click event	Supplementary page description (optional)
November 7, 2023 9:58:09	Recommender's homepage is opened.	Recommender name: Short-term leader
November 7, 2023 9:59:04	The stock detail page is opened.	Jiuzhou yaoye (stock code: 603456)
November 7, 2023 10:00:20	The price chart view is switched to monthly.	Jiuzhou yaoye (stock code: 603456)
November 7, 2023 10:00:59	"Buy" button is clicked.	Jiuzhou yaoye (stock code: 603456)

Panel A: An example of viewing detailed recommendation information through the recommender's homepage

Click time	Click event	Supplementary page description (optional)
November 7, 2023 10:00:03	The message center is opened.	-
November 7, 2023 10:00:09	The message page is opened.	(The detailed recommendation information)
November 7, 2023 10:00:15	The stock detail page is opened.	Jiuzhou yaoye (stock code: 603456)
November 7, 2023 10:03:07	"Buy" button is clicked.	Jiuzhou yaoye (stock code: 603456)

Panel B: An example of viewing detailed recommendation information through the message center

Table A1. Variable definitions

Variable	Definition
Panel A Trading, portfolio, and performance characteristics of investors	
Total asset value (*CNY*)	Average aggregate market value of total investor assets, measured as e sum of market value of cash, stock, and ETF holdings.
# Stocks held	Average number of stocks held in the portfolio.
# ETFs held	Average number of ETFs held in the portfolio.
Holding period (days)	Average number of days from first purchase to the first sale across ewly opened positions.
# Trades (*per month*)	Average number of trades per month.
Trade size (*CNY*)	Average trade size (in CNY).
Annualized turnover	(250 / number of trading days in the period) × (aggregate buy dollar olume + aggregate sell dollar volume during the period) / (2 × average tal asset value) ×100.
Disposition effect (*PGR*/*PLR*)	Ratio of the proportion of gains realized (number of stocks sold at a ain divided by the total number of realized and paper gains) to the oportion of losses realized (number of stocks sold at a loss divided by e total number of realized and paper losses).
Ln (*Size*)	Simple average of logged firm size across all stocks purchased during e period.
Book-to-market ratio	Simple average of book-to-market ratio across all stocks purchased ring the period; book-to-market ratio is defined following Liu, ambaugh, and Yuan (2019).
Momentum_1y	Simple average of past 12-month return across all stocks recommended ring the period.
Annualized portfolio return	(250 / number of trading days in the period) × (portfolio value on end-te – portfolio value on start-date – net cash inflows during the period) / erage portfolio value during the period. Portfolio value includes the lue of cash holdings. This is the formula the broker uses to show rtfolio performance to investors in the app.
Post buy return (*week*)	Simple average of 5-trading day returns of stocks following purchases ring the period.
Post buy return (*month*)	Simple average of 20-trading day returns of stocks following purchases ring the period.
Post sell return (*week*)	Simple average of 5-trading day returns of stocks following sales ring the period.
Post sell return (*month*)	Simple average of 20-trading day returns of stocks following sales ring the period.
Female	Equals one if the investor is female, and zero otherwise.
College education	Equals one if the investor has received higher education (college, ndergraduate, or graduate), and zero otherwise.
Age	Investor age as of 2023.

Account experience	Account age as of 2023.

Panel B Trading and performance characteristics of stock recommenders

# Subscribers	Number of investors who subscribed to the stock recommender during e sample period.
Recommendation period (*days*)	Average number of days between the recommendation date and the end ıte.
# Recommended stocks (*per onth*)	Average monthly number of recommendations made by the stock commender.
Ln (*Size*)	Average of logged firm size across all stocks recommended during the ɛriod.
Book-to-market ratio	Average of book-to-market ratio across all stocks recommended during e period.
Momentum_1y	Average of past 12-month return across all stocks recommended during e period.
Winner ratio (%)	Percentage of recommendations with sell prices greater than buy prices.
Holding-period return (%)	Average holding returns of recommendations, calculated from the commendation date to the end date. Holding return for a recommendation calculated as 100 × (sell price – buy price) / Buy price.

Panel C Variable definitions for regression analysis

Follow recommendation (*10 days*)	Equals one if the investor purchased the recommended stock within) trading days after the recommendation, and zero otherwise.
Follow recommendation (*Same ɣy*)	Equals one if the investor purchased the recommended stock on the me day as the recommendation, and zero otherwise.
Paper loss ratio	Number of positions held with paper losses divided by the number of ɔsitions held. Whether a holding is at a paper loss is determined by the fference between its market value and holding cost. Both figures are ovided by the broker and displayed in the brokerage's mobile ɔplication.
All paper losses	Equals one if all positions are held at a loss, zero otherwise.
Unrealized paper profit	(aggregate market values of holdings – aggregate holding costs of ɔldings) / aggregate holding costs of holdings.
Portfolio return [-5, -1] (%)	100 × (portfolio value on end-date – portfolio values on start-date – ɛt cash inflows) / average portfolio values during the specified window.
Portfolio return [-20, -6] (%)	100 × (portfolio values on end-date – portfolio values on start-date – ɛt cash inflows) / average portfolio values during the specified window.
Portfolio return [-250, -21] (%)	100 × (portfolio values on end-date – portfolio values on start-date – ɛt cash inflows) / average portfolio values during the specified window.
Ln (*Size*)	Logged value of market capitalization of the recommended stock at e end of the previous month.
Book-to-market ratio	Book-to-market ratio of the recommended stock, which is calculated ing information available up to the previous month-end.
Momentum_1y	Returns of the recommended stock over the last 12 months.

Lottery type stock	Equals one if the stock is simultaneously in the top third of iosyncratic skewness and idiosyncratic volatility, and in the bottom ird of price, and zero otherwise. The construction follows Kumar 009) and is based on information available up to the previous trading ıy.
Stock's social media posts	Moving average of the relative number of posts regarding the commended stock over the 10 trading days prior to the commendation. The relative number of posts is measured by the ımber of posts on the online stock forum "Guba" regarding the commended stock, scaled by the average number of posts across all ɔcks on the same day.
Beta	CAPM beta estimated from daily returns using a rolling window of e past 250 trading days.
Analyst recommendation	Equals one if any analyst issued a buy recommendation within 10 ıding days before the recommendation, and zero otherwise.
Halt	Equals one if any stocks in the investor's portfolio are being ıspended from trading on the recommendation day, and zero otherwise.
Cash ratio1	Cash holdings divided by portfolio value.
Cash ratio2	Ratio of the investor's cash holdings to the average position size over e past 250 trading days.
I (*Cash ratio2 > 1*)	Equals one if the investor's cash holdings exceed the average ɔsition size over the past 250 trading days (*Cash ratio2* > 1), and zero herwise.
View message	Equals one if the investor viewed the messages sent by stock commenders in the brokerage's mobile application, either via commenders' homepages or via investors' personal message centers, ıd zero otherwise.

Online Appendix

Table IA1. Trading, portfolio, and performance characteristics of sampled not-subscribing investors (2021–2023)

This table reports portfolio holdings, trading activity, and performance characteristics of a 10% random sample of investors (42,520 investors) who did not subscribe to recommendation services

during the sample period 2021–2023. Variables are first measured at the investor level and averaged across investors.

Variables	Mean	SD	p25	p50	p75
Panel A: Stock trading					
Total asset value (*CNY*)	289,984.75	1,350,461.72	30,002.12	82,013.23	229,177.48
# Stocks held	5.84	6.81	2.36	4.03	7.00
# ETFs held	0.24	0.86	0.00	0.00	0.02
Holding period (*days*)	76.39	90.41	11.71	33.19	106.32
# Trades (*per month*)	13.48	31.42	2.00	4.78	12.81
Trade size (*CNY*)	29,255.89	104,031.75	5,439.29	12,050.85	27,915.35
Annualized turnover (%)	1113.38	1208.25	194.54	559.99	1673.76
Disposition effect (*PGR/PLR*)	17.71	64.376	2.469	5.469	13.645
Panel B: Stock characteristics of purchased stocks					
Ln (*Size*)	16.49	0.92	15.86	16.37	16.99
Book-to-market ratio	0.80	0.98	0.50	0.65	0.87
Momentum_1y (%)	29.59	41.05	3.92	21.18	45.03
Panel C: Performance					
Annualized portfolio return (%)	-8.07	6.44	-15.75	-7.31	-1.52
Post buy return % (*week*)	-0.50	2.01	-1.31	-0.43	0.36
Post buy return % (*month*)	-1.38	4.22	-3.38	-1.35	0.55
Post sell return % (*week*)	-0.36	2.74	-1.37	-0.41	0.52
Post sell return % (*month*)	-1.27	5.30	-3.55	-1.43	0.66
Panel D: Demographic information					
Female	0.43	0.50	.	.	.
College education	0.65	0.45	.	.	.
Age (*years*)	48.60	11.35	40.00	49.00	56.00
Account experience (*years*)	10.41	7.86	3.00	8.00	16.00

Table IA2: Overlap of recommendations across recommenders.

This table reports the frequency with which multiple recommenders are recommending the same stocks on a given day. A stock-day is flagged as "being recommended" when the stock is currently being recommended by any recommender. Then, we classify the flagged stock-day observations into groups based on the number of recommenders concurrently recommending the same stocks. The table reports the time-series average of the number of stocks in each category.

Number of recommenders	Average number of stocks being recommended	Frequency
Total	545.04	100.00%
1	459.69	84.34%
2	50.13	9.20%
3	19.93	3.66%
4	8.22	1.51%
5	3.61	0.66%
6	1.78	0.33%
>=7	1.68	0.31%

Table IA3. Recommendation and retail order imbalance

This table examines whether recommenders' recommendations can predict retail order imbalances. The dependent variables are order imbalances of a particular stock across various forward-looking windows. For stock s on day t, the small-sized order imbalance is defined as:

$$Small\ sized\ order\ imbalance = \frac{BuyVol_{s,t}^{small} - SellVol_{s,t}^{small}}{BuyVol_{s,t}^{small} + SellVol_{s,t}^{small}},$$

where $BuyVol_{s,t}^{small}$ and $SellVol_{s,t}^{small}$ denote the total dollar volumes (in CNY) of small-sized buy and sell transactions, respectively. *Stock recommended* is a dummy which equals one if any recommender issues a recommendation on that stock on that day, zero otherwise.

	Future small-sized order imbalance		
	(1)	(2)	(3)
Forward-looking window	[1, 5]	[1, 10]	[1, 20]
Stock recommended	0.031***	0.070***	0.129***
	(11.65)	(16.88)	(19.89)
Stock FE	Y	Y	Y
Date FE	Y	Y	Y
Observations	3,336,115	3,336,115	3,336,115
R-squared	0.118	0.176	0.260

Table IA4. Robustness checks: paper loss and following recommendation

This table reports robustness checks of the baseline regressions in Table 5. Columns (1) to (2) use the alternative dependent variable *Follow recommendation* (*Same day*), which indicates investors' following decisions only on the recommendation day. Column (3) excludes all observations during the periods when investors subscribed to multiple recommender services. Column (4) excludes observations from the first six months following the subscription. Column (5) excludes investors whose concurrent portfolio returns are better than the returns of stocks being recommended. Column (6) excludes the top-two followed recommenders. Column (7) estimates the effect of holding paper-loss positions using piecewise functions.

Follow recommendation	*Same day*				*10 days*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Ex. multi-Subscription	Ex. 6 months	Ex. smart investors	Ex. most followed	
Paper loss ratio	-0.060***		-0.065***	-0.052***	-0.075***	-0.089***	
	(-35.58)		(-31.13)	(-24.77)	(-34.98)	(-27.26)	
All paper losses		-0.040***					
		(-45.66)					
Paper loss ratio [0,0.2)							-0.037
							(-1.02)
Paper loss ratio [0.2,0.4)							-0.060***
							(-12.08)
Paper loss ratio [0.4,0.6)							-0.120***
							(-10.98)
Paper loss ratio [0.6,0.8)							-0.138***
							(-9.58)
Paper loss ratio [0.8,1.0]							-0.195***
							(-23.27)
Controls	Y	Y	Y	Y	Y	Y	Y
Investor-recommender FE	Y	Y	Y	Y	Y	Y	Y

Date FE	Y	Y	Y	Y	Y	Y	Y
Observations	1,732,428	1,732,428	1,143,020	1,016,733	1,506,228	494,183	1,732,428
R-squared	0.217	0.219	0.250	0.223	0.229	0.269	0.228

Table IA5. Paper loss and recommendation return relative to investor portfolio

This table reports the relationship between holding paper-loss positions and the subsequent recommendation return relative to the investor portfolio over different holding periods (5, 10, 20, 60, and 250 trading days). The dependent variables are defined as the return of the recommended stock minus the return of the investor's equal-weighted portfolio over the same designated period. Other specifications are the same as Column (5) of Table 5.

	Relative return to investor portfolio				
	(1)	(2)	(3)	(4)	(5)
Holding period	[1, 5]	[1, 10]	[1, 20]	[1, 60]	[1, 250]
Paper loss ratio	7.575***	2.643***	3.241***	1.233***	0.309***
	(8.76)	(9.89)	(15.17)	(8.35)	(12.86)
Controls	Y	Y	Y	Y	Y
Investor FE	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y
Observations	1,732,428	1,732,428	1,732,428	1,732,428	1,732,428
R-squared	0.240	0.328	0.356	0.402	0.424

Table IA6. Changes in stock preferences

This table explores whether holding losses changes investors' preference on stock characteristics at the time of recommendations. We augment the baseline specification by interacting the *Paper loss ratio* with various characteristics of the recommended stocks, including *Ln* (*Size*), *Book-to-market ratio*, *Momentum_1y*, *Lottery type stock*, *Stock's social media posts*, and *Beta*. Columns (1)–(6) report specifications that add these interaction terms sequentially. Other specifications are the same as Column (5) of Table 5.

	Follow recommendation (*10 days*)					
	(1)	(2)	(3)	(4)	(5)	(6)
Paper loss ratio	-0.067***	-0.071***	-0.070***	-0.070***	-0.070***	-0.072***
	(-35.76)	(-35.31)	(-36.91)	(-38.09)	(-37.35)	(-32.87)
Paper loss ratio × *Stock characteristics*	-0.000	-0.003	-0.001	-0.005	-0.000	0.001
	(-0.33)	(-0.38)	(-0.76)	(-1.29)	(-0.58)	(0.41)
Ln (*Size*)	0.001					
	(1.31)					
Book-to-market ratio		0.006***				
		(2.79)				
Momentum_1y			0.006***			
			(4.68)			
Lottery type stock				0.023***		
				(10.68)		
Stock's social media posts					0.003***	
					(10.20)	
Beta						0.002***
						(2.63)
Other controls	Y	Y	Y	Y	Y	Y
Investor-recommender FE	Y	Y	Y	Y	Y	Y

Date FE	Y	Y	Y	Y	Y	Y
Observations	1,732,428	1,732,428	1,732,428	1,732,428	1,732,428	1,732,428
R-squared	0.226	0.226	0.226	0.226	0.226	0.226

Table IA7. Generalization: Paper-loss positions and buying new stocks

This panel examines the relationship between holding paper-loss positions and the likelihood of investors buying a new stock on a given day. *Buy* equals one if the investor buys a new stock on a given day, and zero otherwise. This analysis uses a 10% random sample of investors who did not subscribe to recommendation services during 2021–2023. The regression includes the same portfolio-based control variables as Table 5, investor and date fixed effects. Standard errors are clustered at the investor level. *t*-statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Buy	
	(1)	(2)
Paper loss ratio	-0.130***	
	(-89.65)	
All paper losses		-0.115***
		(-98.48)
Controls	Y	Y
Investor FE	Y	Y
Date FE	Y	Y
Observations	27,884,430	27,884,430
R-squared	0.194	0.206

Table IA8. Generalization: Reinvestment day

This table uses a 10% random sample of investors who did not subscribe to recommendation services during 2021–2023. The analysis is conducted at the investor–day level. Panel A replicates Table 4 of Frydman, Hartzmark, and Solomon (2018) by examining whether investors exhibit a reduced disposition effect on reinvestment days in the non-subscriber sample. The samples are restricted to sell days. Following Odean (1998), *PGR* is defined as the number of stocks sold at a gain divided by the total number of stocks with realized and unrealized gains, and *PLR* is defined as the number of stocks sold at a loss divided by the total number of stocks with realized and unrealized losses. *Difference* is the average difference between *PGR* and *PLR*, with the t-statistic (clustered by investor and date) for the test that this is zero underneath. *All* includes all observations; *Reinvestment day* includes only sell days on which a new position is purchased. Panel B examines the relationship between *Paper loss ratio* (*All paper losses*) and *Reinvestment day* . The dependent variable, *Reinvestment day* equals one if the investor sells an existing position and purchases a new stock on the same day, and zero otherwise. The key independent variable is *Paper loss ratio* (*All paper losses*). The regression includes the same portfolio-based control variables as Table 5, investor and date fixed effects. Standard errors are clustered at the investor level. *t*-statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

Panel A. Replication of Frydman, Hartzmark and Solomon (2018) results

	All	*Reinvestment day*
	(1)	(2)
PGR	0.480	0.421
PLR	0.199	0.250
Difference	0.281***	0.171***
	(10.20)	(3.94)
Observations	2,785,732	1,220,699

Panel B. Paper-loss positions and reinvestment day

	Reinvestment day	
	(1)	(2)
Paper loss ratio	-0.090***	
	(-118.60)	
All paper losses		-0.083***
		(-84.76)
Controls	Y	Y
Investor FE	Y	Y
Date FE	Y	Y
Observations	27,884,430	27,884,430
R-squared	0.221	0.231