Does Trading Volume Mitigate or Amplify Mispricing?

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Abstract

We find that when volume is relatively low, trading volume is primarily driven by attention rather than disagreement. An increase in volume, reflecting heightened attention, can mitigate mispricing stemming from limited attention. In contrast, when volume is relatively high, we find a stronger correlation between volume and disagreement than attention. Here, an increase in volume, suggesting heightened disagreement, may enhance investor bias, thereby amplifying mispricing driven by such bias. Overall, whether trading volume amplifies or mitigates mispricing depends on both the volume state (high or low) and the source of mispricing, whether due to limited attention or investor bias.

Keywords: Trading volume, Mispricing, Limited Attention, Disagreement, Behavioral Bias

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1. Introduction

Behavioral finance seeks to improve our understanding of financial data by employing models that incorporate assumptions about investors' beliefs, preferences, and cognitive limitations. Prominent findings link mispricing to two key forces: investor bias (e.g., extrapolative beliefs), and limited attention (Daniel, Hirshleifer, and Sun, 2020; Chen, He, Tao, and Yu, 2022).

Moreover, Han et al. (2022) have demonstrated that trading volume, when viewed as a measure of disagreement, can amplify mispricing. This is in line with Atmaz and Basak's (2018) suggestion that disagreement may intensify investor bias, thus leading to amplified mispricing, as observed in Han et al. (2022). On the other hand, Hou, Peng, and Xiong (2009) argue that trading volume, considered as an indicator of attention, can reduce certain forms of mispricing, such as earnings momentum, a notable mispricing anomaly attributable to limited attention.[1]

This raises two crucial questions: First, does trading volume amplify or mitigate mispricing? Second, how to interpret trading volume as a measure of disagreement or attention, is it state-dependent? In this paper, we carry out an exhaustive investigation to address these questions and supply the associated economic explanations.

Empirically, we conduct a five-by-five independent double sort on post-earnings announcement drift (PEAD) and trading volume.[2] Our findings show that the monthly CAPM alpha of the PEAD long-short (L-S) portfolio decreases from 0.99% for low-volume (quintile 1) stocks to 0.10% for medium-volume (quintile 3) stocks, a difference of -0.89% (t-value = -3.81). It increases from 0.10% for medium-volume (quintile 3) stocks to 0.69% for high-volume (quintile 5) stocks, a difference of 0.59% (t-value = 2.77). Consequently, trading volume mitigates PEAD from quintiles 1 to 3 in the low-volume state and amplifies mispricing from quintiles 3 to 5 in the high-volume state.[3]

[1]Chen, He, Tao, and Yu, (2022) document that the anomalies corresponding to many recently proposed anomaly-based prominent factors are less pronounced among firms with high investors' attention proxied by media coverage. Hence, as a potential proxy for investor attention, volume may weaken mispricing anomalies related to attention as documented in Chen, He, Tao, and Yu, (2022). Moreover, like these existing studies, we use "positive volume-return relation" and "volume amplification effect" interchangeably. We also use "negative volume-return relation" and "volume mitigation effect" interchangeably.

[2]Our results are robust using the portfolio sorting based on NYSE-breakpoints and sequential sorting methods. Please refer to the results in Appendix Table A3.

[3] In this paper, we categorize stocks into low-volume state (quintiles 1-3) and high-volume state (quintiles 3-5).

Therefore, we have a U-shaped pattern of PEAD, which is mitigated by volume in the low-volume state while amplified by volume in the high-volume state.

To investigate the underlying mechanisms behind the U-shaped pattern of PEAD, we first show that while trading volume can capture both attention and disagreement, its ability to reflect these components is not fixed but state-dependent. In the low-volume state (quintiles 1-3 stocks), trading volume aligns more with attention than disagreement. Conversely, in the high-volume state (quintiles 3-5 stocks), it corresponds more with disagreement than attention. [4]

Moreover, PEAD is generally more pronounced among firms with less investors' attention (Hou, Peng, and Xiong, 2009; Chen, He, Tao, and Yu, 2022). As such, investor inattention is high in quintile 1 stocks, resulting in substantial PEAD. As volume increases in the low-volume state from quintile 1 to 3, investor attention (inattention) dramatically increases (decreases), thereby reducing PEAD. On the other hand, in the high-volume state (quintiles 3-5 stocks), investor attention is high and mispricing in PEAD due to inattention is minimal. Yet, mispricing in PEAD due to expectation bias might still persist.[5] Hence, an increase in volume implies increased disagreement, exacerbating expectation bias and amplifying PEAD. [6]

In summary, our findings suggest that trading volume serves as a good indicator of disagreement when volume is high and of attention when volume is low. However, it does not act as a good indicator of disagreement when volume is low, nor of attention when volume is high. Therefore, whether to assign trading volume as a measure of either disagreement or attention is state-dependent, and it would be inappropriate to simply make this assignment. Furthermore, the effect of trading volume on mispricing depends on both the volume state and the origin of the mispricing, whether it's driven

Notably, stocks in quintile 3 belong to both the low-volume state and high-volume state categories.

[4] We construct a composite attention measure based on the average ranking of six attention proxies, which include abnormal Google search volume, media coverage, abnormal EDGAR downloads, analyst coverage, price delay, and abnormal Bloomberg downloads. Moreover, we construct a composite disagreement measure based on the average ranking of three disagreement proxies, which include stock return volatility, analysts' return forecast dispersion, and analysts' earnings forecast dispersion.

[5] Barberis, Shleifer, and Vishny (1998) propose an over-extrapolative ("trending") regime, which can be due to investors' biased extrapolative expectations about future earnings.

[6] While excessive attention can intensify mispricing (Barber and Odean, 2008), the high-volume state maintains a consistent level of high attention. Thus, the amplification of PEAD from quintiles 3 to 5 is unlikely to be driven by this stable level of attention, regardless of its height.

by investor bias or limited attention. Specifically, in states of low trading volume, where volume is indicative of attention, it can mitigate mispricing caused by inattention. Conversely, in high-volume states, where volume is reflective of disagreement, it can amplify mispricing arising from bias.

Some anomalies, such as PEAD, primarily reveal investor inattention-driven mispricing in the low-volume state where attention is low. However, other anomalies may be less influenced by inattention and reflect mispricing due more to expectation bias rather than inattention-driven mispricing. An example is the FIN (financing) factor proposed by Daniel, Hirshleifer, and Sun (2020). After examining PEAD, we proceed to analyse the FIN anomaly.

We find that trading volume consistently amplifies FIN mispricing across all levels of trading volume. The monthly CAPM alpha of the FIN portfolio increases from 0.26% (quintile 1) to 0.63% (quintile 3), a difference of 0.37% (t-value = 1.27). It further increases to 1.04% (quintile 5) from 0.63% (quintile 3), with a difference of 0.40% (t-value = 1.53). The total increase from quintiles 1 to 5 is 0.77% (t-value = 2.02). Disagreement increases from quintiles 3 to 5, enhancing expectation bias and intensifying FIN. Since FIN reflects expectation bias rather than inattention-driven mispricing, the mitigation effect from quintiles 1 to 3 is largely muted. However, a significant rise in attention from quintiles 1 to 3 may magnify the effect of disagreement, inducing a volume amplification effect for FIN. Although a similar scenario might occur with the PEAD anomaly among quintiles 1 to 3, the mitigation effect tends to dominate the amplification effect in this low-volume state.

We further analyze the MISP (mispricing) factor of Stambaugh and Yuan (2017). As explained later in the paper, MISP, based on 11 anomalies, is likely significantly influenced by both inattention and expectation bias.[7] In the low-volume state (quintiles 1 to 3), neither volume mitigation nor amplification effect is observed. This could be because the mitigation effect for inattention-driven mispricing and the amplification

[7]Among anomalies used in construction of MISP, some are affected by inattention, such as financial distress, O-score, momentum, gross profitability, and return-on-assets (PERF) (Chen, He, Tao, and Yu, 2022), while other anomalies are affected by expectation bias, such as net share issuance (NSI) and composite share issuance (CSI) which also are used to construct FIN. Therefore, MISP includes the two types of mispricing captured by PEAD and FIN.

effect for expectation bias-driven mispricing in MISP are of similar magnitudes, thereby offsetting each other. However, in the high-volume state, a strong volume amplification is noted. This occurs because from quintiles 3 to 5, attention is consistently high with little change, making inattention-driven mispricing always relatively small with little change or reduction. Meanwhile, the expectation bias-driven mispricing could be amplified as disagreement significantly increases from quintiles 3 to 5.[8]

In addition, we apply Fama-MacBeth analysis to investigate how attention and disagreement might explain volume mitigation and amplification effects on mispricing. The findings are in line with the aforementioned double-sort approach. For example, when regressing one-month-ahead stock returns on PEAD, trading volume, and their interaction, we find a significant negative coefficient on the interaction between PEAD and trading volume, especially for quintiles 1 to 3. This implies that trading volume mitigates the positive prediction of PEAD on stock returns.

As trading volume might convey information beyond investor attention and disagreement, we explored three alternative explanations: arbitrage costs, illiquidity, and private information, using metrics such as IVOL, bid-ask spread, and volume-synchronized probability of informed trading (VPIN). Our findings are robust against these alternative explanations.

Finally, the state-dependent relationship between trading volume and either attention or disagreement is as follows: low attention can result in limited trading volume, as fewer investors are aware of certain stocks. As attention rises, more investors engage in trading, thereby increasing volume. However, if attention is already high, further increases may have a reduced impact on volume, making this relationship more pronounced in a low-volume state. As for disagreement, it can stimulate trading provided a certain level of attention exists for investors to notice it. When attention is low, a rise in disagreement among a smaller group of investors may only marginally increase trading volume. Conversely, when attention is high, the same level of

[8]Our results for MISP are consistent with the findings of Han et al. (2022) that trading volume amplifies mispricing captured by MISP which is mainly concentrated among stocks in high-volume state.

disagreement among a larger group can cause a significant volume increase, making this relationship stronger in a high-volume state.

The rest of the paper is organized as follows. Section 2 provides a brief review on the related literature and some discussions about the contributions of this study. Section 3 describes data and shows the summary statistics. Section 4 presents the main empirical results. Section 5 explores the underlying economic explanations. Section 6 concludes.

2. Literature Review and Contributions

Previous research has found that limited attention can explain many anomalies, such as post-earnings announcement drifts (Hirshleifer, Lim, and Teoh, 2009; DellaVigna and Pollet, 2009; Ben-Rephael, Da and Israelsen, 2017), momentum (Hong, Lim and Stein, 2000; Da, Gurun, and Warachka, 2014), and lead-lag return effects among economically-linked firms, such as customer-supplier links (Cohen and Frazzini, 2008), geographic links (Parsons, Sabbatucci, and Titman, 2020), competition links (Eisdorfer et al., 2022), product similarity (Hoberg and Phillips, 2010, 2016), shared analysts (Ali and Hirshleifer, 2020), among others.

Furthermore, investor bias has important implications for mispricing. One notable concept is the presence of extrapolative beliefs among individuals. This implies that investors' estimation of the future value of a quantity is a positive function of its recent past values. Several studies have utilized survey data to describe investors' extrapolative beliefs about future returns (Bacchetta et al., 2009; Amromin and Sharpe, 2014; Greenwood and Shleifer, 2014). For example, Greenwood and Shleifer (2014) used six survey databases to quantify investors' expectations of stock market returns and found a positive correlation between these expectations and past returns (i.e., extrapolation), while exhibiting a negative relationship with model-based expected returns (i.e., over-extrapolation). Daniel, Hirshleifer, and Sun (2020) motivate the financing factor (FIN) using extrapolative beliefs. Da et al. (2021) observed that individual investors tend to extrapolate from recent past returns, giving more weight to the most recent ones. Furthermore, Liao et al. (2022) applied the extrapolative model to explain the sharp increase in prices and volume observed during historical financial

bubbles.

Overall, a growing body of research proposes various behavioral approaches to explain mispricing or abnormal returns (Barberis, 2018). Inattention and investor bias are two critical factors that play important roles in explaining these phenomena.[9]

In terms of contributions, our study delves into the relationship between trading volume and mispricing, revealing that volume can either reduce mispricing due to increased attention in low-volume states or intensify mispricing driven by investor bias when volume signifies disagreement in high-volume states. This study offers explanations for the divergent outcomes observed in prior literature concerning trading volume's relation to mispricing. While some research indicates trading volume mitigates mispricing as a measure of investor attention (Hou, Peng, and Xiong, 2009), others suggest it amplifies mispricing reflecting belief dispersion (Han et al., 2022). Our findings underscore volume's dual role: both mitigating and amplifying different anomalies depending on whether the mispricing stems from limited attention or expectation bias. Unlike Hou, Peng, and Xiong (2009) who solely view volume as a proxy for attention, we consider it also indicative of disagreement.

Additionally, our study proposes a unique, state-dependent framework for attention and disagreement, the two components of trading volume. Given the challenge of directly measuring investor attention and disagreement, many studies use trading volume as a proxy. For instance, Gervais et al. (2001) suggest high trading volumes increase a stock's visibility, thus attracting more attention. Likewise, Hou, Peng, and Xiong (2009) use trading volume to measure investor attention. Lee and Swaminathan (2000) and Han et al. (2022) interpret trading volume as a measure of disagreement. However, we find that for low-volume state stocks, trading volume aligns closely with attention, whereas its connection with disagreement is less distinct. In contrast, for high-volume state stocks, trading volume correlates more strongly with disagreement than attention. These findings stress that while trading volume reflects both attention and disagreement, their respective weights are state-dependent. As such, caution is advised when using trading volume as a proxy for either attention or disagreement.

[9]There are some other important behavior factors, such as overconfidence.

Moreover, our study contributes to the literature on the trading volume-stock returns relationship. Despite extensive research, a clear understanding remains elusive (Chordia et al., 2001; Llorente et al.,2002; Lo et al., 2000; Israeli et al., 2022; Gervais et al., 2001; Kaniel et al., 2012). Notably, Chordia et al. (2001) find a negative relationship between stock returns and trading volume, while Gervais et al. (2001) observe a high-volume return premium. We propose that this discrepancy could be due to the intricate dynamics between trading volume and mispricing, contingent on both volume states and mispricing origins. For instance, in high-volume states, we find a positive volume-returns relationship for underpriced stocks, but a negative relationship for overpriced stocks when mispricing primarily results from investor bias. Conversely, in low-volume states, the volume-returns relationship reverses: it's negative for underpriced stocks and positive for overpriced stocks, when mispricing is typically driven by limited attention.

3. Data Description and Summary Statistics

This section outlines our methodology for constructing trading volume and our main anomaly variables, as well as proxies for investors' attention and disagreement. Our sample consists of all common stocks (CRSP share codes 10 and 11) listed on NYSE, AMEX, and NASDAQ (CRSP exchange codes 1, 2, and 3) from January 1980 to December 2021, with stocks priced below $1 and stocks with negative book equity being excluded. We obtain stock return data from CRSP, firm accounting and financial statement variables from the merged CRSP-Compustat database, and analyst forecast data from I/B/E/S.

The key variable of interest is trading volume (TO), which is the average turnover over the prior twelve months. The monthly turnover is the number of shares traded during a month divided by the number of shares outstanding at the end of the month. We follow Gao and Ritter (2010) to adjust the volume of Nasdaq stocks. Specifically, we divide the volume by 2.0 before January 2001, by 1.8 for the rest of 2001, by 1.6 for 2002 to 2003, and leave it unchanged afterward.

The main anomaly variables include the short-horizon mispricing factor (PEAD) and long-horizon mispricing factor (FIN) from Daniel, Hirshleifer, and Sun (2020) and the

mispricing factor (MISP) from Stambaugh and Yuan (2017). The PEAD is measured as the 4-day cumulative abnormal return around the most recent quarterly earnings announcement date following Chan, Jegadeesh, and Lakonishok (1996) and Daniel, Hirshleifer and Sun (2020). The FIN is the financing factor based on the 1-year net share issuance (NSI) and 5-year composite share issuance (CSI) measures from Pontiff and Woodgate (2008) and Daniel and Titman (2006), respectively. We follow Daniel, Hirshleifer and Sun (2020)'s method to sort the firms into three financing groups (low "L", middle "M", or high "H") based on NSI and CSI rankings of each month. The MISP is the composite mispricing factor obtained by averaging rankings of 11 anomalies, including net stock issues, composite equity issues, accruals, net operating assets, asset growth, and investment to assets, financial distress, O-score, momentum, gross profitability, and return on assets.

To measure investors' attention, we construct a composite attention index based on six individual attention proxies, which include: (1) abnormal Google search volume, measured as the log difference between Google search volume for a stock in the past one month and the average search volume over the past year, following Da, Engelberg, and Gao (2011). The sample period is from July 2004 to December 2016; (2) media coverage, defined as the number of news articles published on Thomson Reuters News Analytics during the month for each stock. The news data sample period is from January 1996 to December 2021; (3) abnormal EDGAR download, measured as the log difference between the number of EDGAR downloads in the current month and the average number over the past year. [10] The sample period for the search records is from December 2003 to June 2017; (4) analyst coverage, represented by the total number of estimates for the earnings forecasts for the current fiscal year. The data sample period is from March 1983 to December 2021; (5) price delay, the average delay with which a firm's stock price responds to market information (Hou and Moskowitz, 2005).[11] The larger the number, the less attention the corresponding stock receives. Thus, we employ the reciprocal of the delay measure as the attention measure when constructing the

[10]The EDGAR downloads data are available at Ryans' website (http://www.jamesryans.com/) and we follow Ryans (2017)'s method to extract the human downloads.

[11]We use the first delay measure in Hou, et al. (2005), which is $1 - \frac{R^2_{\delta_j^{-n}=0,\forall n\in[1,4]}}{R^2}$, where the denominator is R^2 from regression $r_{j,t} = \alpha_j + \beta_j R_{M,t} + \sum_{n=1}^{4} \delta_j^{-n} R_{M,t-n} + \epsilon_{j,t}$, and the numerator is R^2 from the same regression by restricting $\delta_j^{-n} = 0, \forall n \in [1,4]$. In the regression, $r_{j,t}$ is the return on stock j and $R_{M,t}$ is the market return in month t calculated by Fama and French (1993).

composite attention index. The price delay data is from January 1980 to December 2021; (6) abnormal Bloomberg download, proposed by Ben-Rephael et al., (2017). Specifically, for each stock on each day, the abnormal Bloomberg download is a dummy variable that takes a value of one if Bloomberg's daily maximum score is 3 or 4 and zero otherwise. Then, for each stock in every month, we sum up the abnormal daily Bloomberg download indicators within the month. The data is obtained on Bloomberg terminals from February 2010 to December 2016. For each month, we first convert individual attention measures into ranks and standardize to obtain the z-score. Then, we construct the composite attention index as the average z-score of these six attention proxies.

To measure investors' disagreement, we construct a composite disagreement index based on three individual disagreement proxies, which include (1) stock return volatility, measured as the standard deviation of weekly stock excess returns (from Thursday to Wednesday) over the year ending on the portfolio formation date. The sample period is from January 1980 to December 2021; (2) analysts' return forecast dispersion, which is the standard deviation of analysts' return forecasts. Return forecasts are the 12-month-ahead analysts' target prices forecasted in month t divided by the actual stock price at the beginning of month t. The sample period is from March 1999 to December 2021; (3) analysts' earnings forecast dispersion, which is the standard deviation of analysts' earnings forecast divided by the actual stock price in the same month. The sample period is from March 1982 to December 2021. We follow Han et al. (2022) to include both analysts' return, and earnings forecast dispersion when constructing the composite disagreement proxy. For each month, we first convert individual disagreement measures into ranks and standardize to obtain the z-score. Then, we construct the composite disagreement index as the average z-score of these three disagreement proxies.

Table 1 reports the summary statistics (Panel A) and the time-series average of the cross-sectional correlation coefficients (Panel B) between the variables used in the paper. Notably, the correlation coefficients between TO and Attention, as well as Disagreement are positive and moderately high, suggesting that TO may contain information about both investors' attention and disagreement. The correlation coefficient between MISP and Disagreement is the highest among all the variables,

indicating that MISP may be driven by investors' disagreement, which is consistent with the literature (Han et al., 2022). Panel C of Table 1 reports the monthly value-weighted portfolio average excess returns, CAPM alphas, and Fama-French three-factor alphas sorted by MISP, PEAD and FIN from 1980 to 2021. For example, the portfolio sorted by PEAD has an excess return spread of 0.49%, a CAPM alpha spread of 0.55%, and a Fama-French three-factor alpha spread of 0.60% per month. All of these are statistically significant.

[Insert Table 1 here]

4. Empirical Results

In this section, we report our main empirical results: trading volume mitigates PEAD and amplifies FIN. Specifically, volume mitigates PEAD in low-volume state and amplifies PEAD in high-volume state, and the mitigation effect dominates the amplification effect overall. Meanwhile, the volume amplification effect on FIN persists for stocks across different volume levels.

4.1 Volume mitigation effect on PEAD

We conduct an independent five-by-five double sort on PEAD and trading volume (TO) and obtain 25 value-weighted TO-PEAD portfolios, as shown in Table 2. Specifically, at the end of each month, we sort the stocks into five groups based on TO and sort the stocks into five groups based on PEAD independently. Finally, we have the 25 value-weighted TO-PEAD portfolios.

Panel A of Table 2 reports the value-weighted excess returns of the 25 portfolios, as well as the differences in excess returns for stocks among volume quintile 1, quintile 3 and quintile 5 portfolios. The spread of the PEAD L-S portfolio decreases along with the trading volume, especially among stocks in low-volume state. The PEAD L-S portfolio's average return decreases from 0.98% for volume quintile 1 portfolio to 0.60% for volume quintile 5 portfolio, with a difference of 0.37% (t-value = -1.62). Although insignificant, we do observe the volume mitigation effect on PEAD.

However, when we divide the stocks into low-volume state (quintile 1 to 3) and high-volume state (quintile 3 to 5), we observe a volume mitigation and amplification effect

in the two subsamples, respectively. Specifically, the average return of the L-S portfolio decreases by nearly 0.94% (t-value = -4.17) from volume quintile 1 portfolio to volume quintile 3 portfolio, while the returns increase 0.57% (t-value = 2.68) from volume quintile 3 portfolio to volume quintile 5 portfolio. Therefore, volume mitigates PEAD among stocks in low-volume state and amplifies PEAD among stocks in high-volume state, and the mitigation effect dominates the amplification effect, resulting in an overall mitigation effect.

[Insert Table 2 here]

To examine whether such result is driven by risks, we report the results for value-weighted CAPM-alphas and FF3 alphas of the 25 TO-PEAD portfolios in Panel B and Panel C of Table 2, respectively. The CAPM alpha of PEAD L-S portfolio decreases significantly from 0.99% for quintile 1 to 0.10% for quintile 3 portfolio, with a difference of -0.89% (t-value = -3.81), and then increases to 0.69% for quintile 5 portfolio, with a significant difference of 0.59% (t-value = 2.77). The total decrease of PEAD L-S portfolio CAPM alpha from volume quintile 1 to 5 portfolio is 0.30% (t-value = -1.28). The FF3 alpha of PEAD L-S portfolio decreases from 0.94% for quintile 1 to 0.12% for quintile 3 portfolio, and then increases to 0.77% for quintile 5 portfolio, with differences of -0.83% (t-value = -3.39) and 0.65% (t-value = 3.00), respectively. The total decrease of PEAD L-S portfolio FF3 alpha from volume quintile 1 to 5 portfolio is 0.18% (t-value = -0.80). These results are consistent with those obtained from excess returns, which indicate that trading volume mitigates the mispricing captured by PEAD among stocks in low-volume state and amplifies such mispricing among stocks in high-volume state. Furthermore, the mitigation effect generally dominates the amplification effect, leading to an overall weak mitigation effect.[12]

[12]When we use the equal-weighted method to calculate the alphas of portfolios (see Appendix Table A2 Panel A), we observe the mitigation effects among stocks in both low-volume state and high-volume state. And the magnitudes both decreased compared to the value-weighted results in the baseline. This is related to the fact that firm size increases from TO quintile 1 to 3 and then decrease from TO quintile 3 to 5. Size is positively related to investor attention but negatively related to disagreement. Hence, from TO quintile 1 to 3, the increase in firm size makes the disagreement related amplification effect weaker while attention related mitigation effect stronger that leads to a stronger mitigation effect among stocks in low-volume state when switch from equal- to value-weighted. Similarly, from TO quintile 3 to 5, the decrease in firm size makes the disagreement related amplification effect stronger while attention related mitigation effect weaker that leads to a stronger amplification effect among stocks in high-volume state when switch from equal- to value-weighted method. We further apply the independently triple sort on PEAD, TO and size to control the size effect (see Appendix Table A4 Panel A), consistently, both the magnitudes of mitigation effect among stocks in low-volume state and amplification effect among stocks in high-volume state decrease though still significant.

4.2 Volume amplification effect on FIN

In Table 3, we conduct an independent three-by-five double sort on FIN and trading volume. Specifically, at the end of each month, we sort the stocks into five groups based on TO and we follow Daniel, Hirshleifer, and Sun (2020) to sort the firms into three groups based on the 1-year NSI and 5-year CSI. We finally obtained the 15 value-weighted TO-FIN portfolios. Panel A of Table 3 reports the value-weighted excess returns of the 15 TO-FIN portfolios, as well as the differences in excess returns among volume quintile 1/3/5 portfolios. The spread of FIN long-short (L-S) portfolio increases monotonically in trading volume overall. The average return of L-S portfolios increases from 0.14% for volume quintile 1 portfolio to 0.52% for volume quintile 3 portfolio. It further increases to 0.74% for volume quintile 5 portfolio, showing a persistent volume amplification effect on FIN. The difference of L-S portfolios average return between volume quintile 5 and volume quintile 1 portfolios is 0.60% (t-value = 1.63).

[Insert Table 3 here]

Panel B and Panel C of Table 3 report the value-weighted CAPM alphas and FF3 alphas of the 15 TO-FIN portfolios, respectively. Consistent with the result of excess returns, the FIN L-S CAPM (FF3) alpha increases from 0.26% (0.30%) for volume quintile 1 portfolio to 0.63% (0.56%) for volume quintile 3 portfolio, and further increases to 1.04% (0.83%) for volume quintile 5 portfolio. The total difference of FIN L-S CAPM (FF3) alpha between volume quintile 5 and quintile 1 portfolio is 0.77% (0.53%) with a t-value of 2.02 (1.76).

4.3 Volume amplification effect on MISP

Han et al. (2022) conduct a five-by-five double sort on MISP and trading volume and find that volume amplifies MISP and this amplification effect is mainly concentrated among stocks in high-volume state. In Table 4, we conduct the same test and get consistent results. Panel A of Table 4 reports the value-weighted excess returns of the 25 portfolios, as well as the differences in average returns among volume quintile 1/3/5 portfolios. The spread of MISP long-short (L-S) portfolio increases along with the trading volume especially among stocks in high-volume state. The L-S portfolio return increases from 0.52% for volume quintile 1 portfolio to 1.36% for volume quintile 5

portfolio, with a difference of 0.84% (t-value=3.33). In particular, the L-S portfolio average return almost does not change (the difference is only 0.01% with t-value = 0.04) among stocks in low-volume state. In contrast, the average return of the L-S portfolio increases by 0.83% (t-value = 3.56) from quintile 3 portfolio to quintile 5 portfolio, accounting for the main increase from quintile 1 to 5 portfolio.

[Insert Table 4 here]

Such result is also consistent with our findings of the volume mitigation effect on PEAD and the volume amplification effect on FIN, because that MISP contains price momentum that is related to earnings momentum of PEAD (Chordia and Shivakumar, 2006).[13] In addition, MISP incorporates the net stock issuance (NSI) and composite stock issuance (CSI), which are used to construct FIN. Therefore, based on the construction, MISP contains both types of mispricing that are captured by PEAD and FIN. Among stocks in low-volume state, the mitigation effect on PEAD and the amplification effect on FIN offset each other, and this is consistent with the MISP L-S return difference of 0.01% (t-value = 0.04) between quintile 1 and quintile 3 portfolio. Among stocks in high-volume state, the amplification effects on PEAD and FIN are enhanced, and this is consistent with the MISP L-S return difference of 0.83 (t-value = 3.56) between quintile 3 and quintile 5 portfolio.

To control for more potential risk factors, Panel B and Panel C of Table 4 report the CAPM adjusted alphas and FF3 adjusted alphas of the 25 TO-MISP portfolios, respectively. Consistent with the results for average returns, MISP L-S portfolio CAPM (FF3) alpha does not change too much from volume quintile 1 to quintile 3 portfolio, with a difference of 0.03% (0.12%) and t-value of 0.05 (-0.24). While the MISP L-S portfolio CAPM (FF3) alpha increases significantly from 0.72% (0.74%) for the quintile 3 portfolio to 1.72% (1.70%) for quintile 5 portfolio, with a difference of 1.00% (0.96%) and t-value of 4.48 (4.25).

[13]In Appendix Table A1, we show the average returns/CAPM alphas/FF3 alphas of the 25 portfolios double sorted on price momentum (MOM) and TO, where the MOM is the cumulative return over the past 12 months. For example, in Table A1 panel A, the spread of MOM L-S portfolio decrease among low-volume state stocks (although insignificant) and increase among high-volume state stocks, which display the similar pattern to PEAD.

Hou, Peng and Xiong (2009) document that trading volume, as a proxy of attention, displays a mitigation effect on PEAD for both low- and high-volume state stocks. However, we find a mitigation effect on PEAD for low-volume state stocks but an amplification effect for high-volume state stocks. This difference can be due to the different methods used. Hou, Peng and Xiong (2009) use the equal-weighted method, while we use the value-weighted method. Under the equal-weighted method, small firms play a larger role than under the value-weighted method.

For the PEAD anomaly, the underreaction to the earnings news matters more under the equal-weighted method and the mitigation effect may dominate the amplification effect even for the stocks in high-volume state. Hence, we can have a net mitigation effect on PEAD even for stocks in high-volume state under the equal-weighted method as documented in Hou, Peng and Xiong (2009) but a net amplification effect for stocks in high-volume state under the value-weighted method as documented by this study.

Indeed, when applying the equal-weighted method to calculate the portfolio returns, we find similar results to the literature. In Panel A of Table A2 in the Appendix, we report the equal-weighted CAPM adjusted alphas of the 25 TO-PEAD portfolios and FF3 adjusted alphas of PEAD L-S portfolios. The results are consistent with Hou, Peng and Xiong (2009)'s findings that L-S portfolio average returns and FF3 adjusted alphas decrease across all levels of trading volume.

As for MOM, it should be closely related to PEAD (Chordia and Shivakumar, 2006). Hence, under the equal-weighted method, the mitigation effect for MOM should be stronger than under the value-weighted method. Indeed, we find this is the case. The amplification effect (net the mitigation effect) in Panel B of Table A2 in the Appendix is weaker (stronger) than that in Panel C of Table A1.[14]

5. Economic Interpretation

In this section, we turn to interpret our main empirical results and investigate the underlying two common behavioral forces that drive mispricing. One is the investor's

[14]Although Hou, Peng and Xiong (2009) find the significant amplification effect of trading volume on MOM from low-volume groups to high-volume groups, the difference could be due to different sample selections. We also find a very strong amplification effect on MOM if restricted to their sample period (result upon request).

inattention to new information, which can be mitigated by improved attention. The other one is expectation bias (e.g., overconfidence), which can be amplified by an increase in disagreement. Therefore, in this section, we first aim to inspect the relation between trading volume and investors' attention or disagreement, respectively.

Since both behavioral forces could affect PEAD and they themselves are affected by volume via either the attention channel or the disagreement channel, we examine how trading volume affects PEAD via these two channels. Besides PEAD, we further examine the underlying channel through which trading volume affects other anomalies such as FIN, which is less affected by investor inattention but more by expectation bias, and MISP, which is a composite mispricing score that potentially captures the two types of mispricing and can be affected by both limited attention and expectation bias.

5.1 Investor attention

In this subsection, we examine the relation between investors' attention and trading volume. Although trading volume has been widely used to proxy investors' attention in many literatures (e.g., Barber and Odean, 2008; Chen, Tang, Yao, and Zhou, 2022; Chen, He, Tao, and Yu, 2022), it is considered to be the outcome of investors' attention. Thus, we propose some economic attention inputs to measure investors' attention and then test the relation between investors' attention and trading volume.

Panel A of Table 5 reports the value-weighted investors' attention of portfolios sorted by trading volume (TO). We use the average z-score of six individual attention proxies, including abnormal Google search volume, media coverage, abnormal EDGAR download, analyst coverage, price delay, and abnormal Bloomberg downloads to construct the composite attention index. In general, the investors' attention increases along with the trading volume, especially from volume quintile 1 portfolio to quintile 3 portfolio with a difference of 1.10 (t-value = 14.36). [15]

Panel B of Table 5 reports the value-weighted investors' attention of portfolios double-sorted by PEAD and trading volume (TO). Specifically, among high PEAD portfolios, investors' attention increases from -0.14 for volume quintile 1 portfolio to 1.04 for the

[15]The value-weighted attention decreases slightly from TO quintile 3 to 5 which is consistent with the fact that the firm size also decreases from TO quintile 3 to 5. Thus, it generates the weaker mitigate effect on PEAD among low-volume state stocks when switch equal- to value-weighted method.

quintile 3 portfolio, with a difference of 1.18 (t-value = 22.74), and further increases to 1.07 for volume quintile 5 portfolio, with a difference of 0.04 (t-value = 1.09). The result indicates that trading volume acts as a proxy of investor attention among stocks in low-volume state. The lower the trading volume, the lower the investor attention, and the higher the mispricing captured by PEAD. This is consistent with our empirical result of the volume mitigation effect on PEAD among stocks in low-volume state.

Panel C and Panel D of Table 5 report the value-weighted investors' attention of 15 TO-FIN portfolios and 25 TO-MISP portfolios, respectively. They display a similar pattern to Panel A, where the attention increases with trading volume, especially for stocks in low-volume state.

[Insert Table 5 here]

5.2 Investor disagreement

In this subsection, we examine the relation between investors' disagreement and trading volume. Panel A of Table 6 reports the value-weighted investors' disagreement of portfolios sorted by trading volume (TO). We use the average z-score of three individual disagreement proxies, including stock return volatility, analysts' return forecast dispersion, and analysts' earnings forecast dispersion. In general, investor disagreement increases monotonically from volume quintile 1 to quintile 5 portfolios, which helps explain the volume amplification effect among stocks in high-volume state.

Panel B of Table 6 reports the value-weighted investors' disagreement of portfolios double-sorted by PEAD and trading volume (TO). Within each level of PEAD portfolios, investor disagreement increases monotonically from volume quintile 3 to quintile 5 portfolio, which helps explain the volume amplification effect among stocks in high-volume state. In contrast, among stocks in low-volume state, investor disagreement decreases from quintile 1 to quintile 3 portfolios for majority of PEAD portfolios, indicating that the mitigation effect could be even stronger than the level we observe in Table 2.

Panel C of Table 6 reports the value-weighted investors' disagreement of portfolios double-sorted by FIN and trading volume (TO). In general, for each FIN portfolio, the

investors' disagreement increases along with the trading volume. For instance, investors' disagreement for low-FIN portfolio increases by 0.77 (t-value = 20.16) from volume quintile 1 portfolio to quintile 5 portfolio. Furthermore, the disagreement increases mostly come from stocks in a high-volume state (i.e., from quintile 3 to quintile 5). Within each level of FIN portfolios, investors' disagreement monotonically increases from volume quintile 3 portfolio to quintile 5 portfolio. Similarly, as shown in Panel D of Table 6, disagreement increases in trading volume for double-sorted TO-MISP portfolios.

[Insert Table 6 here]

5.3 Fama-MacBeth analysis

In this section, we provide direct evidence about the amplification and mitigation effects of trading volume on different types of mispricing. Through investigating the relation between trading volume and investors' attention, as well as investors' disagreement, we find that investors' attention increases with trading volume, especially in low-volume state stocks. On the other hand, investors' disagreement increases with trading volume, especially in high-volume state stocks. Based on these findings, we conjecture that trading volume is more likely to proxy investors' attention among low-volume state stocks, while it is more likely to proxy investors' disagreement among high-volume state stocks. We test this conjecture through a series of Fama-MacBeth regressions including trading volume, factors that capture mispricing, investors' attention, disagreement, and their interaction with anomaly variables.

5.3.1 Volume mitigation effect on PEAD

Table 7 reports the Fama-Macbeth results for PEAD. The dependent variable is the one-month-ahead monthly excess return. The independent variables include PEAD, trading volume (TO), Attention and Disagreement. All the independent variables are converted into quintile ranks. We also consider the intersection terms: PEAD*TO, PEAD*Attention, and PEAD*Disagreement. We control firm size which is the logarithm of market capitalization and the logarithm of book-to-market ratio in all the regressions.

Panel A of Table 7 reports the Fama-Macbeth regressions results for the full sample. In

the first four regressions, we include only one of PEAD, trading volume (TO), Attention, and Disagreement as the main independent variable. Higher PEAD indicates greater undervaluation, suggesting that PEAD positively predicts future stock returns. The significant positive coefficients on PEAD (0.225 with a t-value of 13.32) in first regression is consistent with the theory. In the second regression, the coefficient on TO is negative but insignificant, which is consistent with prior studies that the relation between trading volume and future stocks return is ambiguous. In the third regression, the coefficient on Attention is positive and significant. Although we incorporate the retail attention (i.e., Google Search Volume) in our composite attention measure, the other attention measures are more likely to capture the institutional investors' attention (e.g., Edgar download, Bloomberg download and analyst coverage). Thus, the positive coefficient on Attention is consistent with the existing literature that institutional investors' attention is usually positively related to future stock return (Da et al., 2022). The coefficient on investors' disagreement is negative in regression (4) which is also consistent with the theory that stocks with higher disagreement are usually overvalued and negatively related to future returns. Furthermore, the coefficients of PEAD*TO, PEAD*Attention and PEAD*disagreement are negative, negative, and positive in regression (5), (6) and (7), respectively, which are also consistent with the economic rationales that TO (as a proxy for Attention) and Attention could reduce mispricing due to limited attention, while Disagreement can amplify the mispricing due to investor's bias.

[Insert Table 7 here]

We focus on the coefficients on the interaction terms of PEAD and trading volume, investors' attention, as well as disagreement. The results based on the portfolio analysis predict that the coefficients of PEAD*TO should be negative since trading volume can help mitigate PEAD. After attention and its interaction term with PEAD are added into the regression, the magnitude of negative coefficients on PEAD*TO should reduce. Regressions (5) and (8) in Panel A of Table 7 confirm this prediction. We can see that the interaction term of PEAD*TO is -0.0397 (t-value = -4.70) and its magnitude decreases to -0.0287 (t-value = -3.29) when we control the attention variables. It indicates that trading volume is more like an attention proxy for PEAD. Moreover, the magnitude of coefficient on PEAD*TO becomes larger (-0.0517) in regression (9) when

we include disagreement variables. The reason is that after controlling for disagreement, trading volume becomes a purer proxy for attention which would further mitigate the mispricing. In regression (10), when we include all the variables as the independent variables, the magnitude of coefficient on PEAD*TO decreases relative to regression (9), which further indicates that trading volume is more likely to measure attention for PEAD.

We further divide the sample into low-volume state and high-volume state subsample based on trading volume quintile ranks. The low-volume state subsample are stocks from trading volume quintile 1 to quintile 3 and the high-volume subsample are stocks from trading volume quintile 3 to quintile 5.

Panel B of Table 7 is our focus for PEAD, and it reports the results of low-volume state subsample. The results based on the portfolio analysis indicate that the coefficients of PEAD*TO in low-volume state subsample should be more negative and significant, and the magnitude would also decrease when attention and its interaction term with PEAD are added. Regressions (11) and (12) in Panel B of Table 7 confirm this prediction. We can see that the interaction term of PEAD*TO is -0.0478 (t-value = -3.24) of which the magnitude is larger than its coefficient in full sample (see regression (5)). The magnitude also decreases when we add attention variables in regression (12) which is -0.0323 (t-value = -2.05). In regression (14), we include all the variables as the independent variables. As expected, the magnitude of coefficient on PEAD*TO becomes smaller relatively to regression (13) and it is similar to regression (11), which confirms that trading volume is more likely to measure attention for PEAD especially among stocks in low-volume state.

Panel C of Table 7 reports the results of high-volume state subsample. Consistent with our conjecture, the coefficient of PEAD*TO becomes insignificant in high-volume state stocks (see regressions (15) and (16)). But it becomes significantly negative when we add disagreement variables in regression (17), which is consistent with the previous findings that TO becomes a purer attention measure after controlling disagreement. Furthermore, the magnitude of coefficient on PEAD*TO becomes smaller in regression

(18) where we add attention variables. [16]

Overall, the Fama-MacBeth analysis in Table 7 confirms our portfolio analysis in prior sections that the trading volume could mitigate the PEAD because it is more likely to represent attention information for anomalies driven by limited attention and such effect is more pronounced in low-volume state stocks.

5.3.2 Volume amplification effect on FIN

We employ similar Fama-MacBeth regressions for anomaly FIN and report the empirical results in Table 8. The independent variables include FIN, trading volume (TO), Attention, and Disagreement. Consistent with Daniel, Hirshleifer and Sun (2020), we convert FIN into tertile ranks and all the other variables are converted into quintile ranks. Panel A of Table 8 reports the Fama-Macbeth regressions results for the full sample. Higher FIN indicates greater overvaluation, and thus the coefficient on FIN in regression (1) is significantly negative. Furthermore, the coefficients of FIN*TO, FIN*Attention and FIN*disagreement are negative, insignificant, and negative in regression (5), (6) and (7), respectively, which are also consistent with the economic rationales that TO (as a proxy for Disagreement) and Disagreement could amplify FIN mispricing, while Attention is unrelated to FIN mispricing.[17]

[Insert Table 8 here]

We focus on the coefficients on the interaction terms of FIN and trading volume, investors' attention, and disagreement. The coefficient of FIN*TO is negative and significant in regression (5) and it becomes insignificant when we add disagreement variables in regression (8). Such findings confirm the portfolio analysis results that trading volume is more likely to represent the disagreement information for mispricing driven by investors' bias.

[16]Although we do not observe the significant amplification effect of TO on PEAD mispricing among high-volume state stocks using Fama-Macbeth method, the insignificant result is consistent with the double sort results using equal-weighted method.

[17]If we add the triple interaction term FIN*Attention*Disagreement in the regression, the coefficient on the triple interaction term is significant and negative which indicates the attention could enlarge the amplification effect of disagreement on FIN mispricing.

We further divide the sample into low-volume state and high-volume state subsample based on its quintile ranks. Panel B of Table 8 reports the results of low-volume state subsample. Consistent with our conjecture, the coefficients of FIN*TO all become insignificant in low-volume state stocks (see regressions (11) to (14)).

Panel C of Table 8 reports the results of high-volume state subsample. The magnitude of coefficient on FIN*TO in high-volume state groups is larger than that in full sample (see regressions (15) and (5)). And the coefficient of FIN*TO becomes insignificant when we add disagreement and its interaction term with TO in regression (17). These findings are consistent with portfolio analysis results that the trading volume is more likely to measure disagreement for FIN especially in high-volume state stocks.

Overall, the Fama-MacBeth analysis in Table 8 confirms our portfolio analysis in prior sections that trading volume could amplify the FIN because it is more likely to measure disagreement information for anomalies driven by investors' bias and such effect is more pronounced in high-volume state stocks.

5.3.3 Volume amplification effect on MISP

We further employ the similar Fama-MacBeth regressions for anomaly MISP and Table 9 reports empirical results. Panel A of Table 9 reports the Fama-Macbeth regressions results of full sample. In the first four regressions, we only include one of MISP, trading volume (TO), Attention, and Disagreement as the main independent variable. In the first four regressions, we only include one of MISP, trading volume (TO), Attention, and Disagreement as the main independent variable. Higher MISP indicates greater overvaluation, suggesting that MISP negatively predicts future stock returns. The negative coefficient on MISP (-0.326 with a t-value of -8.49) in first regression is consistent with the theory. The coefficients of MISP*TO, MISP*Attention and MISP*disagreement are negative, positive and negative in regression (5), (6) and (7), respectively. Since MISP is related to both limited attention and investor bias, TO and Disagreement could amplify mispricing of MISP while Attention could reduce mispricing of MISP.

[Insert Table 9 here]

The regression coefficients on the interaction terms of MISP and trading volume, investors' attention and disagreement are the focus in this paper. The results based on the portfolio analysis predict that the coefficients of MISP*TO should be negative, and when disagreement and its interaction term with MISP are added into the regression, the magnitude of negative coefficients on MISP*TO should reduce. The regressions (5) and (9) in Panel A of Table 9 confirm this prediction. We can see that the interaction term of MISP*TO is -0.0340 (t-value = -2.76) and it becomes insignificant when we add disagreement variables. It indicates trading volume is more like a disagreement proxy for MISP. Moreover, the magnitude of coefficient on MISP*TO becomes larger (-0.0533) and even more significant (t-value = -4.17) in regression (8) where we include attention variables. The reason is that after controlling for attention, trading volume becomes a purer proxy for disagreement which would further amplify the mispricing. In regression (10), we include all the variables as the independent variables, and the coefficients of MISP*TO becomes insignificant, which further confirms that trading volume is more likely to measure disagreement for MISP.

We further divide the sample into low-volume state and high-volume state subsample based on trading volume quintile ranks. The low-volume state subsample consists of stocks from trading volume quintile 1 to quintile 3 and high-volume state subsample consists of stocks from trading volume quintile 3 to quintile 5.

Panel B of Table 9 reports the results of low-volume state subsample. Consistent with our conjecture, the coefficient of MISP*TO becomes insignificant in low-volume state stocks (see regression (11)) and it even becomes positive (see regressions (13) and (14)) when we include disagreement variables because trading volume is no longer a disagreement proxy for low-volume state stocks, and it may contain other information which could mitigate the MISP instead.

Panel C of Table 9 reports the results of high-volume state subsample. The results based on the portfolio analysis indicate that the coefficients of MISP*TO in high-volume state subsample should be more negative and significant, and the magnitude would also decrease when disagreement and its interaction term with MISP added. The regressions (15) in Panel C of Table 9 confirm this prediction. We can see that the interaction term

of MISP*TO is -0.103 (t-value = -5.19) of which the magnitude is larger than its coefficient in full sample (see regression (5)). The magnitude also decreases when we add disagreement and its interaction term with TO in regression (17) which is -0.0473 (t-value = -2.56), which confirms that trading volume is more likely to measure disagreement for MISP especially in high-volume state stocks.

Overall, the Fama-MacBeth analysis in Table 9 confirms our portfolio analysis in prior sections that trading volume could amplify the MISP because it is more likely to measure disagreement information for anomalies driven by investors' bias and such effect is more pronounced in high-volume state stocks.

5.4 Alternative explanations

In the previous sections, we demonstrated that trading volume is a sensible measure of investor attention among stocks in low-volume state and represents investor disagreement among stocks in high-volume state. However, various alternative explanations have been proposed in the literature, suggesting that trading volume may convey information beyond investor attention and disagreement. In this section, we explore three additional explanations that could potentially lead to a varied volume-return relationship, including arbitrage costs, illiquidity, and private information. We then show that our findings and interpretations remain consistent even after accounting for these factors.

Regarding the first explanation that trading volume might be indicative of arbitrage costs, Stambaugh, Yu, and Yuan (2015) discovered a negative IVOL-return relationship for overpriced stocks and a positive one for underpriced stocks, interpreting IVOL as a proxy for arbitrage costs. Given the positive correlation between trading volume and IVOL, as well as the similarity between IVOL-return and volume-return relationships, it is plausible to suggest that trading volume serves as a proxy for arbitrage costs, akin to IVOL. Consequently, we examine whether the volume mitigation and amplification effect persist after accounting for IVOL. We calculate IVOL as the standard deviation of residuals from Carhart four-factor regressions, using the previous month's daily returns following Ang et al. (2006).

For the second explanation, high trading volume indicates greater liquidity, while low trading volume implies greater illiquidity. Consequently, prior research, such as Glosten and Harris (1988) and Brennan and Subrahmanyam (1995), demonstrates that trading volume is a crucial factor in determining market liquidity. To examine if the volume-return relationship is linked to illiquidity, we employ the bid-ask spread as an illiquidity measure. A higher bid-ask spread corresponds to increased illiquidity, and we utilize Corwin and Schultz (2011)'s approach to calculate the bid-ask spread.

As for the final explanation, trading volume captures information asymmetry or private information. Easley, Kiefer, O'Hara, and Paperman (1996) contend that the likelihood of information-based trading is lower for high-volume stocks, suggesting that trading volume reflects the extent of private information. We adopt Easley, Prado, and O'Hara (2012)'s method to construct the volume-synchronized probability of informed trading (VPIN) to verify whether our primary findings persist after accounting for private information.

Thus, in line with Han et al. (2022), we employ IVOL, bid-ask spread from Corwin and Schultz (2011), and the volume-synchronized probability of informed trading (VPIN) from Easley, Prado, and O'Hara (2012) to gauge arbitrage costs, illiquidity, and private information, respectively. Utilizing Fama-MacBeth regressions, we investigate their impacts on the volume mitigation and amplification effect, while controlling firm characteristics like size and book-to-market ratios.

Table 10 displays the results, with all independent variables converted into quintile ranks. Panel A presents the alternative explanation tests for the trading volume mitigation effect on PEAD. The first regression includes PEAD, trading volume, and their interaction, excluding other competing variables. The negative coefficient of the PEAD interaction with TO indicates that trading volume negatively predicts future stock returns for underpriced stocks, while positively predicting future stock returns for overpriced stocks. This aligns with the mitigation effect of trading volume on PEAD. Regression (2) accounts for the IVOL effect, regression (3) controls for the bid-ask spread, and regression (4) adjusts for VPIN. Regression (5) includes all three alternative explanations. The consistently negative and significant coefficients of the PEAD interaction with TO across all regressions suggest that the trading volume's mitigation

effect on PEAD is robust to alternative explanations.

Panel B and Panel C present the alternative explanation tests for the trading volume amplification effect on FIN and MISP, respectively. For FIN, the coefficients of the FIN interaction with TO remain negative and significant across all regressions. As for MISP, the coefficients of the MISP interaction with TO persist as negative and significant across all regressions, except for the case of they become smaller but still significant at the 10% level when accounting for the IVOL effect. The results suggest that the trading volume's amplification effect on FIN and MISP is also robust to alternative explanations.

6. Conclusion

Our study highlights trading volume's dual function as both an indicator of disagreement and attention, the prominence of which fluctuates depending on the volume state. We find that the impact of trading volume on mispricing is determined by both the volume state and the root of the mispricing, whether it arises from investor bias or limited attention. Specifically, an increase in trading volume may mitigate mispricing resulting from limited attention when it reflects attention in states of low volume. However, when trading volume represents disagreement in high-volume states, it can amplify mispricing driven by investor bias, via exacerbating such bias.

These insights illuminate a nuanced interplay between trading volume, attention, disagreement, and mispricing, offering valuable knowledge into an area that has been relatively under-researched in current literature. This work advances our understanding of these multifaceted dynamics and may have significant applications for future studies.

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Table 1 Summary Statistics

This table reports summary statistics and correlation coefficients for trading volume, three main anomalies, composite attention index and composite disagreement index. Trading volume (TO) is the average turnover over the prior 12 months where the monthly turnover is the number of shares traded during a month divided by the number of shares outstanding at the end of the month. PEAD is the 4-day cumulative abnormal return around earnings announcement following Daniel, Hirshleifer and Sun (2020). FIN is based on the 1-year net share issuance (NSI) and 5-year composite share issuance (CSI). We follow Daniel, Hirshleifer and Sun (2020)'s method to sort firms into three financing groups (low "L", middle "M", or high "H") and take value of one for L, two for M and three for H groups. MISP is composite mispricing score which is the average rankings of 11 anomalies including net stock issues, composite equity issues, accruals, net operating assets, asset growth, investment to assets, financial distress, O-score, momentum, gross profitability, and return on assets from Stambaugh and Yuan (2017). Attention is the average z-score of six individual attention measures which include abnormal Google search volume, media coverage, abnormal EDGAR download, analyst coverage, price delay and abnormal Bloomberg download. Disagreement is the average z-score of three individual disagreement measures which include stock return volatility, analysts' return forecast dispersion and analysts' earnings forecast dispersion. Panel A reports the time-series average (mean), standard deviation (std), minimum (min), quantile 25 (Q25), median, quantile 75 (Q75) and maximum (max). Panel B reports the time-series average of the cross-sectional Pearson correlation between all the variables. Panel C reports anomalies' monthly average excess returns, CAPM alphas and FF3 alphas. The sample period is from January 1980 to December 2021. Value weighted monthly excess returns and alphas are reported in percentages and t-statistics are reported in parentheses.

Panel A: Summary statistics

variable	mean	std	min	Q25	median	Q75	max
TO	1.17	2.60	0.01	0.38	0.78	1.37	89.41
PEAD	0.00	0.09	-0.59	-0.04	0.00	0.04	1.24
FIN	2.09	0.48	1.00	2.00	2.00	2.00	3.00
MISP	49.13	13.38	10.56	39.70	48.29	57.78	94.68
Attention	0.00	1.00	-2.18	-0.77	-0.01	0.77	2.28
Disagreement	0.00	1.00	-1.83	-0.82	-0.02	0.84	1.78

Panel B: Correlations

variable	TO	PEAD	FIN	MISP	Attention	Disagreement
TO	1.00					
PEAD	-0.02	1.00				
FIN	0.16	-0.01	1.00			
MISP	0.11	-0.09	0.52	1.00		
Attention	0.24	-0.01	-0.02	-0.11	1.00	
Disagreement	0.27	0.00	0.21	0.33	-0.14	1.00

Panel C: Anomaly returns

	Average excess return			CAPM alpha			FF3 alpha		
	S	L	L-S	S	L	L-S	S	L	L-S
PEAD	0.49 *	0.98 ***	0.49 ***	-0.39 ***	0.15 **	0.55 ***	-0.40 ***	0.20 ***	0.60 ***
	(1.89)	(4.14)	(4.34)	(-5.76)	(2.20)	(5.05)	(-6.18)	(3.31)	(5.96)
	L	S	L-S	L	S	L-S	L	S	L-S
FIN	1.07 ***	0.47 *	0.60 ***	0.43 ***	-0.44 ***	0.87 ***	0.36 ***	-0.38 ***	0.73 ***
	(6.15)	(1.72)	(3.13)	(3.29)	(-4.74)	(4.29)	(3.89)	(-4.87)	(5.32)
	L	S	L-S	L	S	L-S	L	S	L-S
MISP	0.88 ***	0.04	0.84 ***	0.25 ***	-0.93 ***	1.17 ***	0.24 ***	-0.95 ***	1.19 ***
	(4.94)	(0.14)	(4.22)	(3.64)	(-7.16)	(6.36)	(4.22)	(-7.91)	(7.23)

Table 2 Average returns and alphas of portfolios sorted by PEAD and volume

This table reports the value-weighted average excess returns, CAPM alphas and FF3 alphas of portfolios double sorted on PEAD and trading volume (TO). Short leg refers to the quintile with the lowest PEAD and Long leg refers to the quintile with the highest PEAD. L-S (H-L) refers to the long-short PEAD (high-minus-low volume) portfolio spread. All portfolios are rebalanced monthly. Value-weighted monthly excess returns and alphas are reported in percentages and t-statistics are reported in parentheses. The sample period is from January 1980 to December 2021.

Panel A: Average return								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Short	0.17	0.46 *	0.80 ***	0.43	0.44	0.63 ***	-0.36	0.27
	(0.72)	(1.93)	(3.59)	(1.60)	(1.28)	(3.84)	(-1.56)	(1.02)
2	0.61 ***	0.81 ***	0.81 ***	0.64 ***	0.85 ***	0.20	0.04	0.24
	(2.69)	(4.69)	(3.77)	(2.78)	(2.59)	(1.22)	(0.22)	(0.93)
3	0.81 ***	0.73 ***	0.80 ***	0.74 ***	0.81 **	-0.01	0.01	0.00
	(4.81)	(4.36)	(4.52)	(3.24)	(2.45)	(-0.10)	(0.06)	(0.00)
4	0.82 ***	0.77 ***	0.75 ***	0.77 ***	0.83 ***	-0.06	0.08	0.02
	(3.92)	(4.34)	(3.82)	(3.52)	(2.71)	(-0.43)	(0.39)	(0.07)
Long	1.14 ***	1.22 ***	0.84 ***	1.00 ***	1.04 ***	-0.31 *	0.20	-0.10
	(4.56)	(5.45)	(3.95)	(4.14)	(3.16)	(-1.69)	(0.84)	(-0.34)
L-S	0.98 ***	0.76 ***	0.04	0.56 ***	0.60 ***	-0.94 ***	0.57 ***	-0.37
	(6.19)	(4.29)	(0.24)	(3.70)	(3.66)	(-4.17)	(2.68)	(-1.62)

Panel B: CAPM alpha								
Short	-0.46 ***	-0.24	0.07	-0.45 ***	-0.69 ***	0.53 ***	-0.76 ***	-0.22
	(-2.79)	(-1.62)	(0.57)	(-3.77)	(-4.37)	(3.20)	(-3.46)	(-0.86)
2	0.07	0.25 **	0.16 *	-0.15 *	-0.17	0.09	-0.33 *	-0.25
	(0.41)	(2.17)	(1.71)	(-1.82)	(-1.15)	(0.52)	(-1.90)	(-0.99)
3	0.35 **	0.20 *	0.19 *	-0.01	-0.24 *	-0.16	-0.43 **	-0.59 ***
	(2.52)	(1.78)	(1.75)	(-0.09)	(-1.77)	(-1.20)	(-2.31)	(-2.61)
4	0.30 *	0.22 **	0.10	0.01	-0.12	-0.21	-0.22	-0.42 *
	(1.92)	(2.02)	(1.07)	(0.09)	(-0.90)	(-1.36)	(-1.28)	(-1.95)
Long	0.53 ***	0.58 ***	0.17	0.18 *	0.00	-0.36 *	-0.17	-0.52 *
	(2.69)	(3.45)	(1.39)	(1.87)	(0.00)	(-1.92)	(-0.66)	(-1.68)
L-S	0.99 ***	0.82 ***	0.10	0.62 ***	0.69 ***	-0.89 ***	0.59 ***	-0.30
	(6.11)	(5.12)	(0.68)	(3.96)	(4.28)	(-3.81)	(2.77)	(-1.28)

Panel C: FF3 alpha								
Short	-0.54 ***	-0.32 **	0.03	-0.49 ***	-0.64 ***	0.56 ***	-0.67 ***	-0.10
	(-3.98)	(-2.42)	(0.21)	(-4.11)	(-4.80)	(3.42)	(-3.29)	(-0.50)
2	-0.04	0.22 *	0.12	-0.20 **	-0.13	0.16	-0.25	-0.09
	(-0.30)	(1.85)	(1.31)	(-2.55)	(-0.94)	(1.13)	(-1.46)	(-0.44)
3	0.27 **	0.14	0.13	-0.06	-0.18	-0.14	-0.31 *	-0.45 **
	(2.17)	(1.50)	(1.56)	(-0.60)	(-1.35)	(-0.99)	(-1.83)	(-2.11)
4	0.20 *	0.18	0.07	0.00	-0.04	-0.14	-0.11	-0.24
	(1.73)	(1.64)	(0.73)	(0.00)	(-0.33)	(-1.11)	(-0.64)	(-1.37)
Long	0.41 ***	0.53 ***	0.14	0.20 **	0.13	-0.26 *	-0.02	-0.28
	(3.02)	(3.51)	(1.19)	(2.15)	(0.97)	(-1.65)	(-0.09)	(-1.27)
L-S	0.94 ***	0.85 ***	0.12	0.69 ***	0.77 ***	-0.83 ***	0.65 ***	-0.18
	(5.78)	(5.29)	(0.79)	(4.46)	(4.88)	(-3.39)	(3.00)	(-0.80)

Table 3 Average returns and alphas of portfolios sorted by FIN and volume

This table reports the value-weighted average excess returns, CAPM alphas and FF3 alphas of portfolios double sorted on FIN and trading volume (TO). Long leg refers to the quintile with the lowest FIN and Short leg refers to the quintile with the highest FIN. L-S (H-L) refers to the long-short FIN (high-minus-low volume) portfolio spread. All portfolios are rebalanced monthly. Value-weighted monthly excess returns and alphas are reported in percentages and t-statistics are reported in parentheses. The sample period is from January 1980 to December 2021.

Panel A: Average return

	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Long	0.95 ***	0.99 ***	1.01 ***	1.17 ***	1.33 ***	0.06	0.32	0.38
	(4.17)	(5.91)	(5.23)	(4.88)	(4.94)	(0.34)	(1.49)	(1.54)
2	0.74 ***	0.74 ***	0.79 ***	0.75 ***	0.92 ***	0.05	0.12	0.18
	(4.35)	(4.49)	(4.02)	(3.34)	(3.04)	(0.43)	(0.69)	(0.80)
Short	0.81 ***	0.54 **	0.50 **	0.33	0.59	-0.31	0.10	-0.21
	(2.93)	(2.40)	(2.25)	(1.13)	(1.59)	(-1.32)	(0.36)	(-0.64)
L-S	0.14	0.45 **	0.52 ***	0.84 ***	0.74 **	0.38	0.22	0.60
	(0.64)	(2.47)	(2.96)	(3.17)	(2.45)	(1.31)	(0.67)	(1.63)

Panel B: CAPM alpha								
Long	0.48 **	0.47 ***	0.40 **	0.44 **	0.49 ***	-0.08	0.09	0.01
	(2.42)	(3.27)	(2.39)	(2.37)	(2.61)	(-0.42)	(0.45)	(0.05)
2	0.27 **	0.17 ***	0.12 *	-0.04	-0.06	-0.15	-0.18	-0.33
	(2.02)	(2.75)	(1.68)	(-0.76)	(-0.56)	(-1.30)	(-1.16)	(-1.63)
Short	0.21	-0.08	-0.24 *	-0.56 ***	-0.55 ***	-0.45 *	-0.31	-0.76 **
	(0.97)	(-0.47)	(-1.83)	(-4.06)	(-2.87)	(-1.80)	(-1.36)	(-2.24)
L-S	0.26	0.55 ***	0.63 ***	1.00 ***	1.04 ***	0.37	0.40	0.77 **
	(1.23)	(3.18)	(3.12)	(3.37)	(3.33)	(1.27)	(1.53)	(2.02)
Panel C: FF3 alpha								
Long	0.35 **	0.37 ***	0.32 **	0.32 **	0.45 ***	-0.03	0.13	0.10
	(2.09)	(2.97)	(2.33)	(2.49)	(2.61)	(-0.17)	(0.63)	(0.44)
2	0.19 *	0.14 **	0.07	-0.05	-0.02	-0.12	-0.09	-0.20
	(1.85)	(2.50)	(1.31)	(-0.84)	(-0.15)	(-1.17)	(-0.64)	(-1.14)
Short	0.05	-0.17	-0.24 *	-0.52 ***	-0.38 ***	-0.29	-0.14	-0.43 *
	(0.30)	(-1.15)	(-1.79)	(-4.65)	(-2.59)	(-1.49)	(-0.62)	(-1.74)
L-S	0.30	0.54 ***	0.56 ***	0.84 ***	0.83 ***	0.26	0.27	0.53 *
	(1.42)	(3.03)	(3.35)	(4.50)	(3.65)	(0.98)	(0.92)	(1.76)

Table 4 Average returns and alphas of portfolios sorted by MISP and volume

This table reports the value-weighted average excess returns, CAPM alphas and FF3 alphas of portfolios double sorted on MISP and trading volume (TO). Long leg refers to the quintile with the lowest MISP and Short leg refers to the quintile with the highest MISP. L-S (H-L) refers to the long-short MISP (high-minus-low volume) portfolio spread. All portfolios are rebalanced monthly. Value-weighted monthly excess returns and alphas are reported in percentages and t-statistics are reported in parentheses. The sample period is from January 1980 to December 2021.

Panel A: Average return								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Long	0.75 ***	0.85 ***	0.85 ***	0.84 ***	1.20 ***	0.11	0.35 *	0.45 **
	(4.01)	(5.33)	(4.77)	(3.98)	(4.45)	(0.71)	(1.74)	(2.18)
2	0.91 ***	0.85 ***	0.87 ***	0.63 ***	1.14 ***	-0.04	0.27	0.23
	(4.71)	(4.69)	(4.59)	(2.74)	(4.07)	(-0.27)	(1.64)	(1.04)
3	0.99 ***	0.78 ***	0.63 ***	0.92 ***	1.01 ***	-0.36 **	0.39	0.03
	(4.62)	(3.64)	(2.81)	(4.15)	(3.12)	(-2.27)	(1.47)	(0.08)
4	0.67 ***	0.76 ***	0.73 ***	0.60 **	0.70 **	0.06	-0.03	0.03
	(2.84)	(3.37)	(3.18)	(2.13)	(2.10)	(0.40)	(-0.13)	(0.13)
Short	0.22	0.46 *	0.32	0.03	-0.16	0.10	-0.48 *	-0.39
	(0.77)	(1.78)	(1.22)	(0.10)	(-0.40)	(0.53)	(-1.92)	(-1.24)
L-S	0.52 **	0.39 **	0.53 ***	0.81 ***	1.36 ***	0.01	0.83 ***	0.84 ***
	(2.56)	(2.00)	(3.07)	(3.97)	(5.56)	(0.04)	(3.56)	(3.33)

Panel B: CAPM alpha								
Long	0.28 *	0.35 ***	0.26 ***	0.12	0.34 **	-0.03	0.08	0.05
	(1.93)	(3.14)	(2.72)	(1.21)	(2.57)	(-0.18)	(0.48)	(0.28)
2	0.41 ***	0.24 **	0.21 **	-0.14 **	0.18	-0.21	-0.02	-0.23
	(2.99)	(2.46)	(2.44)	(-1.98)	(1.42)	(-1.31)	(-0.14)	(-1.11)
3	0.51 ***	0.17	-0.07	0.12	-0.03	-0.58 ***	0.05	-0.54 **
	(2.83)	(1.19)	(-0.67)	(1.18)	(-0.18)	(-3.62)	(0.19)	(-2.02)
4	0.11	0.15	0.03	-0.26 *	-0.37 **	-0.07	-0.40 *	-0.47 *
	(0.55)	(1.14)	(0.21)	(-1.94)	(-2.28)	(-0.46)	(-1.68)	(-1.69)
Short	-0.41 **	-0.24	-0.46 ***	-0.92 ***	-1.38 ***	-0.05	-0.92 ***	-0.97 ***
	(-2.10)	(-1.28)	(-3.26)	(-6.43)	(-6.67)	(-0.27)	(-3.90)	(-2.98)
L-S	0.69 ***	0.59 ***	0.72 ***	1.04 ***	1.72 ***	0.03	1.00 ***	1.02 ***
	(3.57)	(2.99)	(4.52)	(5.53)	(7.67)	(0.12)	(4.48)	(3.82)

Panel C: FF3 alpha								
Long	0.23 *	0.31 ***	0.23 ***	0.11	0.39 ***	0.00	0.16	0.16
	(1.93)	(3.03)	(2.64)	(1.27)	(3.11)	(-0.03)	(0.90)	(0.83)
2	0.30 **	0.21 **	0.16 *	-0.18 **	0.22 *	-0.14	0.06	-0.08
	(2.52)	(2.10)	(1.89)	(-2.46)	(1.77)	(-1.04)	(0.39)	(-0.41)
3	0.39 ***	0.07	-0.14	0.09	0.04	-0.53 ***	0.18	-0.35 *
	(3.06)	(0.62)	(-1.37)	(0.89)	(0.29)	(-3.91)	(0.89)	(-1.68)
4	-0.02	0.06	-0.06	-0.29 **	-0.28 *	-0.04	-0.22	-0.26
	(-0.13)	(0.55)	(-0.45)	(-2.24)	(-1.95)	(-0.29)	(-1.10)	(-1.19)
Short	-0.56 ***	-0.38 ***	-0.52 ***	-0.95 ***	-1.31 ***	0.05	-0.80 ***	-0.75 ***
	(-3.50)	(-2.61)	(-3.62)	(-6.73)	(-7.90)	(0.29)	(-3.97)	(-3.34)
L-S	0.80 ***	0.69 ***	0.74 ***	1.06 ***	1.70 ***	-0.05	0.96 ***	0.91 ***
	(4.68)	(3.96)	(4.86)	(5.49)	(8.28)	(-0.24)	(4.25)	(3.90)

Table 5 Investor attention and trading volume

This table reports the value-weighted investors' attention of portfolios sorted by trading volume (TO) in Panel A and value-weighted investors' attention of portfolios double-sorted by PEAD/FIN/MISP and trading volume (TO) in Panel B, C and D, respectively. Low/Medium/High volume refers to volume quintile 1/3/5. And M-L/H-M/H-L refers to medium-minus-low/high-minus-medium/high-minus-low portfolio difference in investors' attention. The attention measure is an average z-score of six individual attention proxies which include abnormal Google search volume, media coverage, abnormal EDGAR download, analyst coverage, price delay and abnormal Bloomberg download. All portfolios are rebalanced monthly, and t-statistics are reported in parentheses. The sample period is from January 1980 to December 2021.

Panel A: Investor attention sorted by TO

	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Investor attention	0.15 *	1.08 ***	1.24 ***	1.23 ***	1.12 ***	1.10 ***	-0.12 ***	0.98 ***
	(1.92)	(14.68)	(28.86)	(29.84)	(30.77)	(14.36)	(-4.84)	(11.37)

Panel B: Investor attention sorted by PEAD and TO								
1	-0.15 ***	0.73 ***	1.06 ***	1.12 ***	1.03 ***	1.21 ***	-0.03	1.18 ***
	(-3.76)	(10.67)	(25.54)	(26.67)	(28.08)	(25.96)	(-0.83)	(21.94)
2	0.08	1.09 ***	1.23 ***	1.24 ***	1.13 ***	1.16 ***	-0.10 ***	1.05 ***
	(1.21)	(16.77)	(30.76)	(31.64)	(28.49)	(15.77)	(-4.05)	(12.75)
3	0.12 *	1.15 ***	1.27 ***	1.25 ***	1.13 ***	1.15 ***	-0.14 ***	1.01 ***
	(1.66)	(17.83)	(32.25)	(31.11)	(30.42)	(15.68)	(-5.73)	(12.51)
4	0.11 *	1.07 ***	1.28 ***	1.26 ***	1.14 ***	1.17 ***	-0.14 ***	1.03 ***
	(1.88)	(14.35)	(29.08)	(31.54)	(32.93)	(16.29)	(-5.52)	(13.91)
5	-0.14 ***	0.69 ***	1.04 ***	1.09 ***	1.07 ***	1.18 ***	0.04	1.21 ***
	(-3.55)	(9.52)	(27.09)	(23.68)	(34.18)	(22.74)	(1.09)	(23.32)
Panel C: Investor attention sorted by FIN and TO								
1	0.05	1.18 ***	1.25 ***	1.23 ***	1.09 ***	1.20 ***	-0.16 ***	1.04 ***
	(0.66)	(14.35)	(19.46)	(18.21)	(22.00)	(13.46)	(-3.19)	(11.68)
2	0.26 ***	1.20 ***	1.25 ***	1.25 ***	1.14 ***	0.99 ***	-0.10 ***	0.89 ***
	(3.03)	(19.56)	(30.68)	(30.61)	(27.73)	(11.05)	(-5.42)	(9.45)
3	-0.12 ***	0.67 ***	1.03 ***	0.99 ***	1.05 ***	1.14 ***	0.03	1.17 ***
	(-2.95)	(12.65)	(17.51)	(21.39)	(40.30)	(19.77)	(0.55)	(27.31)

Panel D: Investor attention sorted by MISP and TO								
1	0.13	1.19 ***	1.33 ***	1.27 ***	1.14 ***	1.20 ***	-0.19 ***	1.01 ***
	(1.24)	(17.48)	(35.76)	(27.85)	(25.08)	(11.50)	(-6.73)	(8.49)
2	0.11 *	1.01 ***	1.23 ***	1.24 ***	1.15 ***	1.12 ***	-0.08 **	1.04 ***
	(1.78)	(13.26)	(28.89)	(29.48)	(29.27)	(15.42)	(-2.42)	(13.29)
3	-0.04	0.75 ***	1.13 ***	1.21 ***	1.14 ***	1.17 ***	0.01	1.18 ***
	(-1.40)	(10.87)	(23.74)	(29.95)	(30.84)	(24.78)	(0.33)	(26.61)
4	-0.13 **	0.59 ***	0.99 ***	1.07 ***	1.08 ***	1.13 ***	0.08 **	1.21 ***
	(-2.41)	(8.35)	(19.49)	(23.38)	(29.33)	(17.93)	(2.05)	(19.33)
5	-0.26 ***	0.39 ***	0.72 ***	0.93 ***	0.91 ***	0.98 ***	0.19 ***	1.17 ***
	(-5.87)	(5.61)	(11.24)	(17.78)	(26.03)	(13.07)	(3.86)	(21.20)

Table 6 Investor disagreement and trading volume

This table reports the value-weighted investors' disagreement of portfolios sorted by trading volume (TO) in Panel A and value-weighted investors' disagreement of portfolios double-sorted by PEAD/FIN/MISP and trading volume (TO) in Panel B, C and D, respectively. Low/Medium/High volume refers to volume quintile 1/3/5. And M-L/H-M/H-L refers to medium-minus-low/high-minus-medium/high-minus-low portfolio difference in investors' disagreement. The disagreement measure is the average z-score of three individual disagreement proxies which include stock return volatility, analysts' return forecast dispersion and analysts' earnings forecast dispersion. All portfolios are rebalanced monthly, and t-statistics are reported in parentheses. The sample period is from January 1980 to December 2021.

Panel A: Investor disagreement sorted by TO

	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Investor disagreement	-0.98 ***	-1.03 ***	-0.93 ***	-0.61 ***	-0.04	0.06	0.89 ***	0.94 ***
	(-43.79)	(-33.15)	(-27.32)	(-13.87)	(-0.83)	(1.20)	(28.08)	(14.95)

Panel B: Investor disagreement sorted by PEAD and TO								
1	-0.41 ***	-0.65 ***	-0.67 ***	-0.40 ***	0.16 ***	-0.27 ***	0.84 ***	0.57 ***
	(-9.73)	(-16.56)	(-23.10)	(-10.82)	(4.55)	(-5.95)	(25.89)	(12.69)
2	-0.91 ***	-1.03 ***	-0.93 ***	-0.63 ***	-0.07	-0.02	0.87 ***	0.85 ***
	(-40.35)	(-36.89)	(-28.36)	(-16.03)	(-1.50)	(-0.54)	(30.54)	(17.53)
3	-1.07 ***	-1.13 ***	-0.99 ***	-0.68 ***	-0.11 **	0.08 *	0.87 ***	0.96 ***
	(-42.03)	(-41.68)	(-29.80)	(-15.60)	(-2.11)	(1.80)	(26.81)	(14.16)
4	-0.96 ***	-1.08 ***	-0.95 ***	-0.66 ***	-0.14 ***	0.01	0.81 ***	0.82 ***
	(-35.29)	(-40.67)	(-29.06)	(-15.59)	(-2.81)	(0.20)	(25.38)	(13.83)
5	-0.41 ***	-0.65 ***	-0.70 ***	-0.44 ***	0.07 *	-0.28 ***	0.76 ***	0.48 ***
	(-8.78)	(-16.39)	(-31.31)	(-13.55)	(1.68)	(-5.65)	(20.85)	(7.18)
Panel C: Investor disagreement sorted by FIN and TO								
1	-1.01 ***	-1.08 ***	-0.93 ***	-0.69 ***	-0.24 ***	0.08 **	0.69 ***	0.77 ***
	(-28.40)	(-28.82)	(-24.65)	(-14.78)	(-5.33)	(2.04)	(19.48)	(20.16)
2	-1.04 ***	-1.08 ***	-0.90 ***	-0.59 ***	-0.07	0.14 ***	0.84 ***	0.98 ***
	(-48.55)	(-39.68)	(-26.39)	(-14.53)	(-1.51)	(3.04)	(29.98)	(16.88)
3	-0.71 ***	-0.78 ***	-0.71 ***	-0.36 ***	0.19 ***	0.00	0.89 ***	0.89 ***
	(-14.74)	(-21.00)	(-19.31)	(-9.63)	(5.38)	(0.03)	(25.14)	(19.09)

Panel D: Investor disagreement sorted by MISP and TO								
1	-1.04 ***	-1.13 ***	-1.00 ***	-0.75 ***	-0.28 ***	0.03	0.72 ***	0.75 ***
	(-35.80)	(-36.30)	(-27.01)	(-16.07)	(-6.07)	(0.55)	(21.98)	(11.68)
2	-0.97 ***	-1.01 ***	-0.92 ***	-0.63 ***	-0.14 ***	0.05	0.78 ***	0.83 ***
	(-28.75)	(-28.86)	(-25.49)	(-15.92)	(-2.84)	(1.21)	(24.77)	(14.16)
3	-0.91 ***	-0.87 ***	-0.85 ***	-0.57 ***	-0.03	0.05	0.82 ***	0.88 ***
	(-37.94)	(-22.90)	(-25.34)	(-14.07)	(-0.59)	(1.49)	(19.19)	(16.62)
4	-0.73 ***	-0.83 ***	-0.77 ***	-0.40 ***	0.11 **	-0.04	0.88 ***	0.84 ***
	(-18.65)	(-20.84)	(-25.31)	(-9.30)	(2.56)	(-0.89)	(19.66)	(15.87)
5	-0.35 ***	-0.47 ***	-0.49 ***	-0.21 ***	0.38 ***	-0.14 ***	0.87 ***	0.73 ***
	(-6.85)	(-8.18)	(-13.24)	(-5.07)	(8.96)	(-2.78)	(18.61)	(13.13)

Table 7 Fama-MacBeth tests on returns with trading volume, PEAD, attention and disagreement

The table reports the results of Fama-MacBeth regression. The dependent variable is the one-month ahead monthly excess return in percentage. The independent variables include PEAD quintile rank (PEAD), trading volume quintile rank (TO), Attention quintile rank (Attention), Disagreement quintile rank (Disagreement) and the interaction between PEAD quintile rank and trading volume quintile rank, the interaction between PEAD quintile rank and Attention quintile rank, the interaction between PEAD quintile rank and Disagreement quintile rank. We control firm size which is the logarithm of market capitalization and the logarithm of book-to-market ratio. Panel A reports the regressions results of full sample. We further divide the sample into low-volume state and high-volume state subsample based on trading volume quintile ranks that is the low-volume state subsample are stocks in trading volume quintile 1 to quintile 3 and the high-volume state subsample are stocks in trading volume quintile 3 to quintile 5. Panel B and Panel C report the results of low-volume state subsample and high-volume state subsample, respectively. Intercept and coefficients on controls are unreported for brevity. Newey-West robust t-values with four lags are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively. The sample period is from January 1980 to December 2021.

Panel A: Full sample										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
PEAD	0.225***				0.347***	0.355***	0.0404**	0.405***	0.167***	0.210***
	(13.32)				(13.26)	(13.75)	(1.98)	(13.65)	(6.39)	(6.58)
TO		-0.0669			0.0580			0.00914	0.143***	0.108**
		(-0.95)			(0.74)			(0.12)	(2.87)	(2.18)
Attention			0.0795**			0.217***		0.189***		0.144***
			(2.39)			(5.16)		(5.61)		(4.36)
Disagreement				-0.106			-0.261***		-0.288***	-0.281***
				(-1.28)			(-3.00)		(-4.00)	(-3.89)
PEAD*TO					-0.0397***			-0.0287***	-0.0517***	-0.0448***
					(-4.70)			(-3.29)	(-6.28)	(-5.22)
PEAD*Attention						-0.0439***		-0.0312***		-0.0173**
						(-6.24)		(-4.42)		(-2.36)
PEAD*Disagreement							0.0529***		0.0640***	0.0603***
							(7.87)		(9.60)	(8.94)
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Average R-squared	0.0175	0.0286	0.0184	0.0321	0.0307	0.0205	0.0341	0.0325	0.0388	0.0404
Observations	1819736	1819736	1819736	1819736	1819736	1819736	1819736	1819736	1819736	1819736

	Panel B: Low-volume state subsample				Panel C: High-volume state subsample			
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
PEAD	0.367***	0.419***	0.147***	0.184***	0.261***	0.343***	0.117**	0.184***
	(11.36)	(12.35)	(3.95)	(4.66)	(4.42)	(5.31)	(2.01)	(2.84)
TO	0.252***	0.188**	0.323***	0.282***	-0.133	-0.174**	-0.0325	-0.0652
	(2.86)	(2.16)	(5.31)	(4.56)	(-1.51)	(-2.00)	(-0.50)	(-1.01)
Attention		0.181***		0.133***		0.204***		0.156***
		(6.01)		(4.71)		(4.44)		(3.47)
Disagreement			-0.306***	-0.300***			-0.283***	-0.266***
			(-4.44)	(-4.33)			(-3.33)	(-3.19)
PEAD*TO	-0.0478***	-0.0323**	-0.0576***	-0.0491***	-0.0209	-0.0109	-0.0362**	-0.0283*
	(-3.24)	(-2.05)	(-4.08)	(-3.24)	(-1.41)	(-0.73)	(-2.39)	(-1.85)
PEAD*Attention		-0.0324***		-0.0170**		-0.0369***		-0.0226**
		(-4.14)		(-2.16)		(-3.95)		(-2.37)
PEAD*Disagreement			0.0750***	0.0718***			0.0584***	0.0517***
			(8.92)	(8.53)			(6.43)	(5.67)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Average R-squared	0.0237	0.0255	0.0335	0.0351	0.0303	0.0332	0.0391	0.0417
Observations	1092154	1092154	1092154	1092154	1091534	1091534	1091534	1091534

Table 8 Fama-MacBeth tests on returns with trading volume, FIN, attention and disagreement

The table reports the results of Fama-MacBeth regression. The dependent variable is the one-month ahead monthly excess return in percentage. The independent variables include FIN tertile rank (FIN), trading volume quintile rank (TO), Attention quintile rank (Attention), Disagreement quintile rank (Disagreement) and the interaction between FIN tertile rank and trading volume quintile rank, the interaction between FIN tertile rank and Attention quintile rank, the interaction between FIN tertile rank and Disagreement quintile rank. We control firm size which is the logarithm of market capitalization and the logarithm of book-to-market ratio. Panel A reports the regressions results of full sample. We further divide the sample into low-volume state and high-volume state subsample based on trading volume quintile ranks that is the low-volume state subsample are stocks in trading volume quintile 1 to quintile 3 and the high-volume state subsample are stocks in trading volume quintile 3 to quintile 5. Panel B and Panel C report the results of low-volume state subsample and high-volume state subsample, respectively. Intercept and coefficients on controls are unreported for brevity. Newey-West robust t-values with four lags are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively. The sample period is from January 1980 to December 2021.

Panel A: Full sample										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FIN	-0.354***				0.0251	-0.427***	0.223***	-0.106	0.293***	0.182*
	(-4.75)				(0.31)	(-4.62)	(3.12)	(-1.18)	(3.06)	(1.71)
TO		-0.0730			0.173**			0.200***	0.0582	0.0855
		(-1.19)			(2.23)			(2.61)	(1.00)	(1.44)
Attention			0.0502*			-0.00485		-0.0796*		-0.0387
			(1.77)			(-0.10)		(-1.96)		(-0.95)
Disagreement				-0.0926			0.293***		0.263***	0.233***
				(-1.42)			(3.93)		(4.13)	(3.71)
FIN*TO					-0.106***			-0.124***	-0.0346	-0.0519**
					(-3.52)			(-4.11)	(-1.35)	(-2.00)
FIN*Attention						0.0261		0.0654***		0.0440**
						(1.25)		(3.28)		(2.22)
FIN*Disagreement							-0.173***		-0.156***	-0.143***
							(-5.56)		(-6.17)	(-5.62)
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Average R-squared	0.0201	0.0323	0.0196	0.0358	0.0356	0.0240	0.0390	0.0380	0.0445	0.0465
Observations	1495959	1495959	1495959	1495959	1495959	1495959	1495959	1495959	1495959	1495959

	Panel B: Low-volume state subsample				Panel C: High-volume state subsample			
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
FIN	-0.110	-0.170*	0.133	0.0996	0.295*	0.116	0.463***	0.338*
	(-1.16)	(-1.68)	(1.16)	(0.88)	(1.79)	(0.64)	(2.76)	(1.79)
TO	0.145	0.174	0.0791	0.0914	0.228**	0.226**	0.0444	0.0574
	(1.36)	(1.58)	(0.88)	(0.94)	(2.19)	(2.22)	(0.48)	(0.62)
Attention		-0.0334		-0.000356		-0.0613		-0.0141
		(-0.78)		(-0.01)		(-1.07)		(-0.24)
Disagreement			0.204***	0.198***			0.284***	0.250***
			(3.05)	(2.99)			(3.61)	(3.25)
FIN*TO	-0.0471	-0.0667	0.000593	-0.0103	-0.162***	-0.165***	-0.0652	-0.0739*
	(-1.05)	(-1.35)	(0.01)	(-0.23)	(-3.63)	(-3.75)	(-1.46)	(-1.68)
FIN*Attention		0.0402*		0.0219		0.0590**		0.0345
		(1.81)		(1.09)		(2.30)		(1.33)
FIN*Disagreement			-0.126***	-0.125***			-0.160***	-0.144***
			(-4.23)	(-4.26)			(-5.07)	(-4.52)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Average R-squared	0.0251	0.0275	0.0360	0.0381	0.0333	0.0370	0.0429	0.0461
Observations	897867	897867	897867	897867	897278	897278	897278	897278

Table 9 Fama-MacBeth tests on returns with trading volume, MISP, attention, and disagreement

The table reports the results of Fama-MacBeth regression. The dependent variable is the one-month ahead monthly excess return in percentage. The independent variables include MISP quintile rank (MISP), trading volume quintile rank (TO), Attention quintile rank (Attention), Disagreement quintile rank (Disagreement) and the interaction between MISP quintile rank and trading volume quintile rank, the interaction between MISP quintile rank and Attention quintile rank, the interaction between MISP quintile rank and Disagreement quintile rank. We control firm size which is the logarithm of market capitalization and the logarithm of book-to-market ratio. Panel A reports the regressions results of full sample. We further divide the sample into low-volume state and high-volume state subsample based on trading volume quintile ranks that is the low-volume state subsample are stocks in trading volume quintile 1 to quintile 3 and the high-volume state subsample are stocks in trading volume quintile 3 to quintile 5. Panel B and Panel C report the results of low-volume state subsample and high-volume state subsample, respectively. Intercept and coefficients on controls are unreported for brevity. Newey-West robust t-values with four lags are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively. The sample period is from January 1980 to December 2021.

Panel A: Full sample										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
MISP	-0.326***				-0.224***	-0.462***	0.0899***	-0.343***	0.0799*	0.000184
	(-8.49)				(-5.89)	(-10.11)	(2.69)	(-7.99)	(1.76)	(0.00)
TO		-0.0702			0.0918			0.132**	-0.00688	0.0109
		(-0.99)			(1.35)			(1.99)	(-0.16)	(0.25)
Attention			0.0846**			-0.0351		-0.0826**		0.00299
			(2.53)			(-0.94)		(-2.30)		(0.10)
Disagreement				-0.113			0.385***		0.382***	0.356***
				(-1.36)			(5.21)		(6.29)	(5.96)
MISP*TO					-0.0340***			-0.0533***	0.00230	-0.00881
					(-2.76)			(-4.17)	(0.21)	(-0.80)
MISP*Attention						0.0445***		0.0596***		0.0307***
						(4.77)		(6.18)		(3.60)
MISP*Disagreement							-0.136***		-0.135***	-0.128***
							(-9.77)		(-10.41)	(-10.21)
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Average R-squared	0.0215	0.0282	0.0180	0.0317	0.0335	0.0245	0.0366	0.0355	0.0415	0.0432
Observations	1902176	1902176	1902176	1902176	1902176	1902176	1902176	1902176	1902176	1902176

	Panel B: Low-volume state subsample				Panel C: High-volume state subsample			
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
MISP	-0.335***	-0.398***	-0.0438	-0.0670	0.0861	-0.0848	0.331***	0.226***
	(-7.85)	(-7.99)	(-0.94)	(-1.40)	(1.14)	(-1.09)	(4.34)	(2.87)
TO	0.0869	0.110	0.0288	0.0233	0.187**	0.214**	0.0203	0.0431
	(1.09)	(1.47)	(0.52)	(0.43)	(2.21)	(2.53)	(0.34)	(0.71)
Attention		-0.0153		0.0521*		-0.123***		-0.0143
		(-0.41)		(1.74)		(-2.74)		(-0.35)
Disagreement			0.343***	0.337***			0.392***	0.350***
			(5.71)	(5.66)			(5.48)	(5.08)
MISP*TO	0.0180	0.00430	0.0421***	0.0386**	-0.103***	-0.119***	-0.0473**	-0.0591***
	(1.04)	(0.24)	(2.63)	(2.35)	(-5.19)	(-5.93)	(-2.56)	(-3.13)
MISP*Attention		0.0343***		0.0108		0.0697***		0.0339***
		(2.92)		(1.07)		(6.20)		(3.34)
MISP*Disagreement			-0.121***	-0.120***			-0.143***	-0.130***
			(-8.99)	(-9.41)			(-9.12)	(-8.46)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Average R-squared	0.0257	0.0278	0.0354	0.0371	0.0336	0.0367	0.0421	0.0447
Observations	1141607	1141607	1141607	1141607	1141004	1141004	1141004	1141004

Table 10 Fama-MacBeth tests on returns with trading volume, anomalies, and controls

The table reports the results of Fama-MacBeth regression. The dependent variable is the one-month ahead monthly excess return in percentage. Panel A reports the regression results on PEAD quintile rank (PEAD), trading volume quintile rank (TO) and their interactions. Panel B reports the regression results on FIN tertile rank (FIN), trading volume quintile rank (TO) and their interactions. Panel C reports the regression results on MISP quintile rank (MISP), trading volume quintile rank (TO) and their interactions. IVOL is standard deviation of residuals from Carhart four-factor regressions using the past month of daily return following Ang et al. (2006) from January 1980 to December 2021. Bid-ask spread is calculated following Corwin et al. (2011) from January 1980 to December 2021. VPIN is volume-synchronized probability of informed trading following Easley et al. (2012) from January 1993 to December 2013, thus we create VPIN_dummy which equal to 1 if VPIN is not missing and equal to 0 if VPIN is missing. IVOL, Bid-ask spread and VPIN are all converted into quintile rank. We control firm size which is the logarithm of market capitalization and the logarithm of book-to-market ratio in all the regressions. Intercept and coefficients on controls are unreported for brevity. Newey-West robust t-values with four lags are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Panel A: Full sample for PEAD					
	(1)	(2)	(3)	(4)	(5)
PEAD	0.347***	0.144***	0.165***	0.355***	0.130***
	(13.26)	(5.14)	(5.24)	(13.20)	(4.00)
TO	0.0580	0.109*	0.0529	0.0550	0.0928
	(0.74)	(1.72)	(0.76)	(0.72)	(1.52)
PEAD*TO	-0.0397***	-0.0409***	-0.0326***	-0.0403***	-0.0411***
	(-4.70)	(-5.09)	(-3.93)	(-4.80)	(-5.09)
IVOL		-0.341***			-0.279***
		(-6.16)			(-6.21)
PEAD*IVOL		0.0612***			0.0602***
		(8.66)			(6.90)
Bid-ask spread			-0.290***		-0.104**
			(-5.01)		(-2.23)
PEAD*Bid-ask spread			0.0479***		0.00854
			(6.95)		(1.01)
VPIN				-0.336***	-0.335***
				(-6.91)	(-6.98)
PEAD*VPIN				-0.00605	-0.00751**
				(-1.63)	(-2.09)
VPIN_dummy				1.290***	1.297***
				(7.48)	(7.48)
Controls	Yes	Yes	Yes	Yes	Yes
Average R-squared	0.0307	0.0361	0.0363	0.0329	0.0412
Observations	1819736	1819633	1790037	1819736	1790011

Panel B: Full sample for FIN					
	(6)	(7)	(8)	(9)	(10)
FIN	0.0251	0.361***	0.414***	0.0929	0.517***
	(0.31)	(3.56)	(3.72)	(1.12)	(4.41)
TO	0.173**	0.134*	0.192***	0.180**	0.161**
	(2.23)	(1.90)	(2.65)	(2.33)	(2.36)
FIN*TO	-0.106***	-0.0709***	-0.108***	-0.113***	-0.0917***
	(-3.52)	(-2.74)	(-4.01)	(-3.73)	(-3.52)
IVOL		0.188***			0.148***
		(4.13)			(3.15)
FIN*IVOL		-0.139***			-0.0997***
		(-5.76)			(-4.72)
Bid-ask spread			0.167***		0.0775
			(3.56)		(1.60)
FIN*Bid-ask spread			-0.117***		-0.0561**
			(-4.61)		(-2.35)
VPIN				-0.266***	-0.273***
				(-6.57)	(-6.40)
FIN*VPIN				-0.0151*	-0.0120
				(-1.78)	(-1.55)
VPIN_dummy				1.006***	1.009***
				(7.13)	(7.13)
Controls	Yes	Yes	Yes	Yes	Yes
Average R-squared	1495959	1495910	1475873	1495959	1475862
Observations	0.0356	0.0410	0.0410	0.0382	0.0465

Panel C: Full sample for MISP					
	(11)	(12)	(13)	(14)	(15)
MISP	-0.224***	0.148***	0.200***	-0.246***	0.230***
	(-5.89)	(3.01)	(3.67)	(-6.23)	(4.11)
TO	0.0918	0.0839	0.141**	0.0751	0.0820
	(1.35)	(1.52)	(2.31)	(1.13)	(1.55)
MISP*TO	-0.0340***	-0.0234**	-0.0490***	-0.0304**	-0.0290**
	(-2.76)	(-2.08)	(-3.94)	(-2.50)	(-2.51)
IVOL		0.295***			0.272***
		(6.11)			(6.38)
MISP*IVOL		-0.128***			-0.109***
		(-10.43)			(-10.55)
Bid-ask spread			0.266***		0.0927***
			(5.68)		(2.79)
MISP*Bid-ask spread			-0.118***		-0.0440***
			(-9.50)		(-4.22)
VPIN				-0.398***	-0.410***
				(-7.57)	(-7.71)
MISP*VPIN				0.0169***	0.0176***
				(3.23)	(3.90)
VPIN_dummy				1.256***	1.278***
				(7.39)	(7.48)
Controls	Yes	Yes	Yes	Yes	Yes
Average R-squared	0.0335	0.0390	0.0394	0.0357	0.0441
Observations	1902176	1902051	1846827	1902176	1846796

Appendix

Table A1 Average returns and alphas of portfolios sorted by MOM and volume

This table reports the value-weighted average excess returns, CAPM alphas and FF3 alphas of portfolios double sorted on MOM and trading volume (TO). MOM is cumulative return over the past 12 months. Short leg refers to the quintile with the lowest MOM and Long leg refers to the quintile with the highest MOM. L-S (H-L) refers to the long-short MOM (high-minus-low volume) portfolio spread. All portfolios are rebalanced monthly. Value-weighted monthly returns and alphas are reported in percentages and t-statistics are reported in parentheses. The sample period is from January 1980 to December 2021.

Panel A: Average return								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Short	0.20	0.32	0.33	-0.09	0.01	0.13	-0.32	-0.20
	(0.66)	(0.94)	(1.07)	(-0.25)	(0.02)	(0.70)	(-1.11)	(-0.64)
2	0.63 **	0.66 ***	0.80 ***	0.53 **	0.63 **	0.17	-0.17	0.00
	(2.51)	(2.75)	(3.40)	(1.99)	(2.08)	(0.92)	(-1.20)	(0.01)
3	0.65 ***	0.65 ***	0.74 ***	0.61 ***	0.70 **	0.09	-0.04	0.04
	(3.17)	(3.60)	(3.89)	(2.71)	(2.34)	(0.65)	(-0.20)	(0.18)
4	0.90 ***	0.93 ***	0.83 ***	0.79 ***	0.78 ***	-0.07	-0.05	-0.12
	(4.64)	(5.13)	(4.14)	(3.55)	(2.61)	(-0.43)	(-0.26)	(-0.48)
Long	0.94 ***	1.04 ***	0.95 ***	0.96 ***	1.18 ***	0.01	0.23	0.24
	(4.16)	(4.42)	(3.81)	(3.94)	(3.48)	(0.07)	(1.12)	(0.88)
L-S	0.74 ***	0.72 **	0.62 **	1.05 ***	1.17 ***	-0.11	0.55 **	0.44
	(2.79)	(2.15)	(1.98)	(3.42)	(3.65)	(-0.43)	(1.97)	(1.40)

Panel B: CAPM alpha								
Short	-0.53 **	-0.49 *	-0.58 **	-1.09 ***	-1.17 ***	-0.05	-0.59 **	-0.64 **
	(-2.37)	(-1.79)	(-2.54)	(-4.64)	(-5.13)	(-0.28)	(-2.07)	(-2.58)
2	0.07	0.03	0.11	-0.29 **	-0.36 ***	0.04	-0.47 ***	-0.44 **
	(0.36)	(0.19)	(0.78)	(-2.10)	(-2.72)	(0.21)	(-3.01)	(-2.00)
3	0.12	0.10	0.11	-0.16 *	-0.23 *	-0.01	-0.34 *	-0.35
	(0.70)	(0.84)	(1.03)	(-1.88)	(-1.73)	(-0.09)	(-1.78)	(-1.45)
4	0.42 ***	0.36 ***	0.19 **	0.04	-0.16	-0.23	-0.35 **	-0.58 ***
	(2.63)	(3.55)	(1.99)	(0.47)	(-1.22)	(-1.56)	(-2.14)	(-2.89)
Long	0.38 **	0.39 **	0.23	0.19	0.21	-0.15	-0.02	-0.17
	(2.27)	(2.44)	(1.40)	(1.45)	(1.13)	(-0.80)	(-0.09)	(-0.66)
L-S	0.91 ***	0.88 ***	0.81 ***	1.28 ***	1.38 ***	-0.11	0.58 **	0.47
	(3.72)	(2.71)	(2.60)	(4.38)	(4.74)	(-0.43)	(2.01)	(1.54)

Panel C: FF3 alpha								
Short	-0.64 ***	-0.61 ***	-0.71 ***	-1.21 ***	-1.24 ***	-0.07	-0.52 **	-0.59 **
	(-3.53)	(-2.59)	(-3.80)	(-5.61)	(-5.64)	(-0.36)	(-1.98)	(-2.31)
2	-0.07	-0.12	-0.02	-0.37 ***	-0.39 ***	0.05	-0.37 **	-0.32 *
	(-0.45)	(-0.84)	(-0.14)	(-2.81)	(-2.73)	(0.28)	(-2.18)	(-1.71)
3	0.00	0.04	0.05	-0.22 **	-0.21 *	0.05	-0.26 *	-0.21
	(-0.01)	(0.30)	(0.49)	(-2.51)	(-1.66)	(0.40)	(-1.66)	(-1.13)
4	0.33 **	0.33 ***	0.15	0.03	-0.14	-0.18	-0.29 *	-0.48 ***
	(2.39)	(3.11)	(1.60)	(0.34)	(-1.22)	(-1.38)	(-1.87)	(-2.76)
Long	0.33 **	0.39 ***	0.26 *	0.23 *	0.38 **	-0.07	0.12	0.04
	(2.22)	(2.66)	(1.76)	(1.86)	(2.34)	(-0.40)	(0.62)	(0.19)
L-S	0.98 ***	0.99 ***	0.98 ***	1.44 ***	1.61 ***	0.00	0.64 **	0.64 **
	(3.93)	(3.29)	(3.83)	(5.19)	(5.56)	(0.00)	(2.03)	(1.98)

Table A2 Alphas (equal-weighted) of portfolios sorted by PEAD/MOM and volume

This table reports the equal-weighted CAPM and FF3 alphas of portfolios double sorted on PEAD/MOM and trading volume (TO). Short leg refers to the quintile with the lowest PEAD/MOM and Long leg refers to the quintile with the highest PEAD/MOM in Panel A and Panel B, respectively. L-S (H-L) refers to the long-short PEAD/MOM (high-minus-low volume) portfolio spread. All portfolios are rebalanced monthly. Equal-weighted monthly returns are reported in percentages and t-statistics are reported in parentheses. FF3 alphas are reported in the last row of each panel. The sample period is from January 1980 to December 2021.

Panel A: CAPM and FF3 alphas of portfolios sorted by PEAD and TO								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Short	-0.31 *	-0.45 **	-0.40 **	-0.62 ***	-1.21 ***	-0.09	-0.81 ***	-0.89 ***
	(-1.70)	(-2.59)	(-2.39)	(-3.99)	(-5.10)	(-0.60)	(-4.93)	(-3.24)
2	0.23	0.10	0.11	-0.17	-0.45 **	-0.12	-0.56 ***	-0.67 ***
	(1.21)	(0.68)	(0.84)	(-1.42)	(-2.47)	(-0.94)	(-3.32)	(-2.76)
3	0.40 **	0.34 **	0.14	0.08	-0.48 ***	-0.26 **	-0.62 ***	-0.88 ***
	(2.40)	(2.24)	(1.06)	(0.66)	(-2.72)	(-2.36)	(-3.43)	(-3.69)
4	0.58 ***	0.46 ***	0.30 **	0.10	-0.39 **	-0.28 **	-0.68 ***	-0.96 ***
	(3.25)	(2.82)	(2.25)	(0.72)	(-2.17)	(-2.56)	(-3.88)	(-3.88)
Long	1.15 ***	0.97 ***	0.63 ***	0.23	-0.36 *	-0.52 ***	-0.99 ***	-1.51 ***
	(6.00)	(4.61)	(3.37)	(1.62)	(-1.71)	(-3.68)	(-5.39)	(-5.68)
CAPM alphas	1.47 ***	1.42 ***	1.03 ***	0.86 ***	0.84 ***	-0.44 ***	-0.19	-0.62 ***
	(13.58)	(12.93)	(9.86)	(8.89)	(7.04)	(-3.16)	(-1.43)	(-4.14)
FF3 alphas	1.45 ***	1.44 ***	1.05 ***	0.90 ***	0.87 ***	-0.40 ***	-0.18	-0.58 ***
	(13.05)	(11.99)	(10.73)	(6.99)	(7.45)	(-3.09)	(-1.48)	(-4.04)

Panel B: CAPM and FF3 alphas of portfolios sorted by MOM and TO								
Short	-0.37	-0.45 *	-0.44 *	-1.02 ***	-1.51 ***	-0.08	-1.06 ***	-1.14 ***
	(-1.51)	(-1.90)	(-1.92)	(-4.34)	(-5.46)	(-0.45)	(-5.83)	(-3.84)
2	0.24	0.08	0.00	-0.21	-0.76 ***	-0.24 **	-0.76 ***	-1.00 ***
	(1.28)	(0.50)	(-0.02)	(-1.46)	(-4.38)	(-2.03)	(-4.40)	(-4.28)
3	0.48 ***	0.32 **	0.23 *	0.00	-0.52 ***	-0.25 **	-0.75 ***	-1.00 ***
	(2.86)	(1.97)	(1.68)	(0.01)	(-3.20)	(-2.07)	(-3.98)	(-4.14)
4	0.78 ***	0.58 ***	0.27 **	0.26 **	-0.23	-0.51 ***	-0.50 ***	-1.02 ***
	(4.66)	(3.66)	(2.09)	(2.13)	(-1.45)	(-5.51)	(-3.27)	(-5.04)
Long	1.00 ***	0.87 ***	0.66 ***	0.34 **	-0.14	-0.34 **	-0.80 ***	-1.14 ***
	(5.57)	(4.77)	(3.38)	(2.06)	(-0.65)	(-2.54)	(-4.31)	(-4.91)
CAPM alphas	1.37 ***	1.31 ***	1.10 ***	1.36 ***	1.37 ***	-0.27	0.27	0.00
	(7.20)	(6.82)	(5.02)	(5.61)	(4.94)	(-1.36)	(1.45)	(0.00)
FF3 alphas	1.41 ***	1.38 ***	1.19 ***	1.47 ***	1.52 ***	-0.22	0.32 *	0.10
	(7.29)	(7.32)	(5.49)	(6.06)	(5.71)	(-1.17)	(1.73)	(0.36)

Table A3 Alphas of portfolios with alternative sorting methods

This table reports the CAPM alphas of portfolios sorted by PEAD and trading volume with NYSE-breakpoints and with sequential sort in Panel A, the CAPM alphas of portfolios sorted by FIN and trading volume with NYSE-breakpoints and with sequential sort in Panel B, and the CAPM alphas of portfolios sorted by MISP and trading volume with NYSE-breakpoints and with sequential sort in Panel C. All portfolios are rebalanced monthly. Value-weighted monthly returns are reported in percentages and t-statistics are reported in parentheses. The sample period is from January 1980 to December 2021.

Panel A: CAPM alpha of portfolios sorted by PEAD and TO								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Sort with NYSE breakpoints								
Short	0.09	-0.02	-0.02	-0.56 ***	-0.55 ***	-0.10	-0.53 ***	-0.64 **
	(0.59)	(-0.18)	(-0.14)	(-4.68)	(-3.26)	(-0.66)	(-2.67)	(-2.37)
2	0.19	0.13	-0.05	-0.07	-0.26 *	-0.24	-0.21	-0.45 **
	(1.56)	(1.36)	(-0.52)	(-0.63)	(-1.67)	(-1.58)	(-1.18)	(-2.06)
3	0.17	0.23 **	0.19 *	0.00	-0.21	0.02	-0.41 *	-0.38 *
	(1.57)	(2.37)	(1.71)	(0.00)	(-1.34)	(0.18)	(-1.71)	(-1.70)
4	0.25 **	0.07	0.13	-0.05	-0.17	-0.11	-0.30 *	-0.41 **
	(2.42)	(0.61)	(1.19)	(-0.51)	(-1.14)	(-0.82)	(-1.68)	(-2.11)
Long	0.40 ***	0.19	0.04	0.10	0.00	-0.36 *	-0.04	-0.40
	(2.88)	(1.25)	(0.36)	(0.93)	(0.02)	(-1.84)	(-0.19)	(-1.61)
L-S	0.31 *	0.22	0.06	0.65 ***	0.55 ***	-0.26	0.49 **	0.24
	(1.78)	(1.40)	(0.35)	(4.29)	(3.58)	(-1.12)	(2.43)	(1.02)

Sequential sort with PEAD first								
Short	0.26	0.59 **	0.61 **	0.44 *	0.42	0.35 *	-0.18	0.17
	(1.25)	(2.40)	(2.34)	(1.72)	(1.10)	(1.82)	(-0.78)	(0.52)
2	0.68 ***	0.76 ***	0.79 ***	0.66 ***	0.89 ***	0.11	0.10	0.21
	(3.04)	(3.78)	(4.35)	(2.85)	(2.82)	(0.68)	(0.52)	(0.88)
3	0.79 ***	0.86 ***	0.73 ***	0.88 ***	0.75 **	-0.06	0.02	-0.04
	(4.45)	(5.65)	(4.17)	(4.43)	(2.49)	(-0.37)	(0.09)	(-0.14)
4	0.88 ***	0.85 ***	0.78 ***	0.73 ***	0.91 ***	-0.09	0.13	0.04
	(4.12)	(4.55)	(3.92)	(3.63)	(3.05)	(-0.68)	(0.69)	(0.16)
Long	1.09 ***	1.18 ***	0.89 ***	1.02 ***	1.08 ***	-0.21	0.20	-0.01
	(4.58)	(5.48)	(4.06)	(3.99)	(3.15)	(-1.07)	(0.84)	(-0.04)
L-S	0.84 ***	0.58 ***	0.28 *	0.58 ***	0.66 ***	-0.56 **	0.38 *	-0.18
	(4.91)	(3.83)	(1.91)	(3.50)	(3.49)	(-2.41)	(1.86)	(-0.72)

Panel B: CAPM alpha of portfolios sorted by FIN and TO								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Sort with NYSE breakpoints								
Long	0.35 **	0.40 **	0.32 **	0.41 **	0.53 ***	-0.03	0.21	0.18
	(2.30)	(2.27)	(2.01)	(2.01)	(2.87)	(-0.18)	(1.07)	(0.87)
2	0.17 ***	0.15	0.10 *	-0.12 *	-0.06	-0.07	-0.16	-0.23
	(2.77)	(1.54)	(1.70)	(-1.68)	(-0.50)	(-0.86)	(-1.14)	(-1.52)
Short	-0.02	-0.11	-0.47 ***	-0.45 ***	-0.57 ***	-0.45	-0.10	-0.55 *
	(-0.10)	(-0.79)	(-3.08)	(-3.65)	(-2.99)	(-1.56)	(-0.47)	(-1.76)
L-S	0.37 **	0.51 ***	0.79 ***	0.86 ***	1.10 ***	0.42	0.31	0.73 **
	(2.06)	(2.89)	(2.77)	(2.92)	(3.63)	(1.12)	(1.06)	(2.00)
Sequential sort with FIN first								
Long	0.48 ***	0.62 ***	0.24	0.33 *	0.47 **	-0.23	0.22	-0.01
	(2.82)	(3.66)	(1.48)	(1.84)	(2.37)	(-1.42)	(1.27)	(-0.06)
2	0.32 **	0.22 ***	0.11	0.00	-0.07	-0.21 *	-0.18	-0.40 **
	(2.38)	(2.87)	(1.43)	(0.04)	(-0.73)	(-1.82)	(-1.22)	(-2.08)
Short	0.03	-0.41 ***	-0.42 ***	-0.51 ***	-0.67 ***	-0.45 *	-0.25	-0.71 *
	(0.20)	(-3.54)	(-3.10)	(-3.18)	(-2.59)	(-1.91)	(-1.11)	(-1.90)
L-S	0.45 ***	1.03 ***	0.67 **	0.84 ***	1.14 ***	0.22	0.47 *	0.69 *
	(2.96)	(4.85)	(2.48)	(3.37)	(2.89)	(0.79)	(1.66)	(1.66)

Panel C: CAPM alpha of portfolios sorted by MISP and TO								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Sort with NYSE breakpoints								
Long	0.32 ***	0.27 **	0.24 **	0.31 ***	0.34 **	-0.08	0.10	0.02
	(3.48)	(2.35)	(2.24)	(2.66)	(2.52)	(-0.70)	(0.54)	(0.12)
2	0.19	0.15	0.06	-0.02	0.28 **	-0.13	0.22	0.09
	(1.62)	(1.46)	(0.74)	(-0.16)	(2.04)	(-0.97)	(1.33)	(0.45)
3	0.24 **	0.06	-0.01	-0.21 *	-0.03	-0.25 *	-0.02	-0.27
	(2.37)	(0.51)	(-0.14)	(-1.83)	(-0.19)	(-1.69)	(-0.09)	(-1.38)
4	0.14	0.08	0.10	-0.11	-0.08	-0.04	-0.18	-0.22
	(1.06)	(0.57)	(0.84)	(-0.91)	(-0.45)	(-0.24)	(-0.83)	(-0.89)
Short	-0.14	-0.15	-0.36 **	-0.76 ***	-1.05 ***	-0.22	-0.69 ***	-0.91 ***
	(-0.88)	(-1.27)	(-2.55)	(-6.39)	(-5.70)	(-0.99)	(-3.88)	(-3.35)
L-S	0.45 ***	0.42 ***	0.60 ***	1.07 ***	1.39 ***	0.15	0.79 ***	0.94 ***
	(3.01)	(3.13)	(3.00)	(5.95)	(6.68)	(0.58)	(3.98)	(3.90)

Sequential sort with MISP first								
Long	0.47 ***	0.35 ***	0.29 ***	0.03	0.35 ***	-0.17	0.06	-0.12
	(3.54)	(3.19)	(2.75)	(0.32)	(2.95)	(-1.18)	(0.35)	(-0.63)
2	0.47 ***	0.29 ***	0.22 **	0.00	0.04	-0.26 *	-0.18	-0.43 **
	(3.45)	(2.60)	(2.28)	(0.02)	(0.32)	(-1.79)	(-1.13)	(-2.18)
3	0.42 **	0.18	-0.06	0.08	-0.02	-0.48 ***	0.04	-0.44
	(2.30)	(1.18)	(-0.52)	(0.88)	(-0.13)	(-2.93)	(0.19)	(-1.64)
4	0.15	-0.02	0.03	-0.25 **	-0.37 **	-0.12	-0.40 *	-0.52 *
	(0.84)	(-0.13)	(0.24)	(-2.16)	(-2.21)	(-0.74)	(-1.79)	(-1.87)
Short	-0.45 **	-0.31 *	-0.65 ***	-0.90 ***	-1.56 ***	-0.20	-0.91 ***	-1.11 ***
	(-2.36)	(-1.80)	(-4.55)	(-5.54)	(-5.75)	(-0.96)	(-3.85)	(-2.90)
L-S	0.91 ***	0.66 ***	0.94 ***	0.93 ***	1.91 ***	0.03	0.97 ***	0.99 ***
	(4.67)	(3.52)	(4.56)	(4.55)	(6.17)	(0.10)	(4.40)	(2.88)

Table A4 Alphas of portfolios controlling size effect

This table reports the CAPM alphas of portfolios independently triple sort on PEAD (FIN or MISP), trading volume and size (using NYSE-breakpoints). All portfolios are rebalanced monthly. Value-weighted monthly alphas are reported in percentages and t-statistics are reported in parentheses. The sample period is from January 1980 to December 2021.

Panel A: CAPM alpha of portfolios triple sort on PEAD, TO and size

	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Short	-0.45 ***	-0.24 *	-0.07	-0.43 ***	-0.79 ***	0.38 ***	-0.71 ***	-0.33
	(-2.75)	(-1.69)	(-0.62)	(-3.88)	(-4.61)	(2.73)	(-3.87)	(-1.30)
2	0.06	0.19 *	0.15	-0.10	-0.29 **	0.09	-0.44 ***	-0.36
	(0.33)	(1.67)	(1.62)	(-1.01)	(-2.10)	(0.63)	(-2.80)	(-1.35)
3	0.30 **	0.26 **	0.16	0.09	-0.30 **	-0.15	-0.46 ***	-0.61 ***
	(2.36)	(2.28)	(1.30)	(0.82)	(-2.39)	(-1.51)	(-2.62)	(-3.00)
4	0.36 **	0.34 ***	0.18 *	0.06	-0.19	-0.18	-0.37 **	-0.55 **
	(2.19)	(3.21)	(1.67)	(0.71)	(-1.37)	(-1.61)	(-2.25)	(-2.52)
Long	0.42 **	0.56 ***	0.33 ***	0.21 **	-0.09	-0.09	-0.43 **	-0.52 *
	(1.99)	(4.01)	(2.87)	(2.20)	(-0.54)	(-0.51)	(-2.06)	(-1.72)
L-S	0.88 ***	0.79 ***	0.41 ***	0.64 ***	0.69 ***	-0.47 **	0.29 **	-0.18
	(5.07)	(6.04)	(4.00)	(5.57)	(5.13)	(-2.41)	(2.01)	(-0.80)

Panel B: CAPM alpha of portfolios triple sort on FIN, TO and size								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Long	0.53 ***	0.48 ***	0.41 **	0.50 ***	0.34 *	-0.12	-0.07	-0.19
	(2.83)	(3.31)	(2.57)	(2.82)	(1.77)	(-0.80)	(-0.40)	(-0.87)
2	0.32 **	0.26 ***	0.19 *	0.01	-0.18	-0.13	-0.37 ***	-0.50 ***
	(2.33)	(2.95)	(1.88)	(0.18)	(-1.50)	(-1.49)	(-2.73)	(-2.63)
Short	0.25	-0.05	-0.18 *	-0.47 ***	-0.69 ***	-0.43 *	-0.51 **	-0.94 ***
	(1.11)	(-0.31)	(-1.72)	(-3.61)	(-3.80)	(-1.88)	(-2.51)	(-2.80)
L-S	0.28	0.53 ***	0.59 ***	0.97 ***	1.03 ***	0.31	0.45 **	0.75 **
	(1.46)	(4.04)	(3.52)	(3.72)	(3.69)	(1.19)	(2.02)	(2.16)

Panel C: CAPM alpha of portfolios triple sort on MISP, TO and size								
	Low Volume	2	Medium Volume	4	High Volume	M-L	H-M	H-L
Long	0.42 ***	0.46 ***	0.37 ***	0.31 ***	0.38 **	-0.05	0.01	-0.04
	(3.17)	(4.29)	(3.09)	(2.91)	(2.51)	(-0.53)	(0.06)	(-0.21)
2	0.40 ***	0.34 ***	0.33 ***	0.10	0.11	-0.07	-0.23	-0.30
	(2.91)	(3.33)	(2.91)	(1.14)	(0.78)	(-0.63)	(-1.64)	(-1.55)
3	0.55 ***	0.29 **	0.14	0.17	-0.07	-0.41 ***	-0.22	-0.63 **
	(3.10)	(1.99)	(1.26)	(1.53)	(-0.45)	(-3.22)	(-1.10)	(-2.53)
4	0.15	0.17	0.01	-0.09	-0.37 **	-0.14	-0.39 **	-0.53 **
	(0.82)	(1.29)	(0.09)	(-0.87)	(-2.43)	(-0.96)	(-2.01)	(-2.01)
Short	-0.32	-0.33 **	-0.51 ***	-0.91 ***	-1.43 ***	-0.19	-0.93 ***	-1.12 ***
	(-1.34)	(-2.05)	(-3.98)	(-6.52)	(-7.11)	(-0.93)	(-4.67)	(-3.57)
L-S	0.74 ***	0.79 ***	0.88 ***	1.22 ***	1.82 ***	0.14	0.94 ***	1.08 ***
	(3.72)	(5.03)	(6.56)	(6.52)	(8.34)	(0.65)	(5.40)	(4.07)