JOURNAL OF ECONOMIC DEVELOPMENT 61
Volume 48, Number 4, December 2023

INVESTOR SENTIMENT AND SHORTED-STOCK RETURN*

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This study examines the role of firm-specific sentiment in the returns on shorted stocks in the Korean stock market. We find evidence that a low or high firm-specific sentiment predicts relatively lower shorted stock returns, whereas a mild sentiment does not. As the sentiment effect on stock returns is stronger in extreme sentiment than mild sentiment, this evidence supports the hypothesis that short sellers are skilled in analyzing firm-specific sentiment. The effect of sentiment on shorted stock returns is pronounced for stocks with a high return volatility, low profitability, high price-to-earnings ratio, high momentum, and a low book-to-market ratio. In contrast, margin traders are not skilled at analyzing firm-specific sentiment, and short sellers possess superior skills compared to margin traders.

Keywords: Short Selling, Margin Trading, Firm-Specific Investor Sentiment, Korean Stock Market
JEL Classification: G41, G14, G11

1. INTRODUCTION

A vast body of literature provides empirical evidence that suggests short sellers are informed traders capable of predicting stock returns. Empirical findings consistently suggest that short sales are inversely related to future stock returns (e.g., Seneca, 1967; Desai et al., 2002; Asquith et al., 2005; Boehme et al., 2006; Boehmer et al., 2008). This negative relationship between short interest and future stock returns has also been reported in Japan, the UK, and China (e.g., Takahashi, 2010; Mohamad et al., 2013; Chang et al., 2014).

* We are grateful Seokgyun Hur, Serena Lee, Jeongseok Song, and Wonho Song for their helpful comments. This paper is a modification of one of the first author's Ph.D. dissertation chapters. This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2021S1A5A2A01063784).

On the other hand, it is well documented that sentiment is positively related to future returns. There is ample empirical evidence suggesting that investor sentiment influences stock returns. Individual investors are considered uninformed or sentiment-driven traders. In the absence of arbitrageurs, changes in investor sentiment play an important role in determining stock prices (Shleifer and Summers, 1990). Later studies provide empirical evidence for this theoretical prediction. Kumar and Lee (2006) empirically show that changes in aggregated investor sentiment affect stock price co-movement. Barber and Odean (2008) argue that retail investors make sentiment-driven decisions and purchase attention-grabbing stocks. Moreover, Berkman et al. (2012) argue that retail investors, described as sentiment-driven investors, tend to buy stocks that attract investors' attention at opening prices, creating upward pricing pressures. In addition, such pricing patterns are found to be more pronounced during periods of high investor sentiment.

This paper investigates the relationship between investor sentiment and shorted stock returns. To this end, we assume that short sellers are informed traders, shorted stock returns are negative, and the return difference between shorted and non-shorted stocks is negative. We also assume that investor sentiment is positively related to future stock returns on average. Both assumptions are well documented in the literature. We further assume differential effects of sentiment on stock returns. The effect of sentiment on future return not only varies in time and across stocks but also is stronger in extreme sentiment rather than mild sentiment. If short sellers possess the ability to analyze differential effects of sentiment on stock returns, they can use it to choose stocks to be short and enhance short selling profits. The ability to analyze sentiment indicates such sentiment-based stock selection skills. Notably, sentiment and information differ each other, and informed short sellers do not necessarily imply that they possess sentiment-analyzing ability. We can hypothesize the relationship between sentiment and shorted stock returns for the case where informed short sellers also possess such ability.

As investor sentiment exerts stronger effects in extreme sentiment rather than mild sentiment, short sellers pay more attention to extreme sentiment. The sentiment-based stock selection skills combined with differential attention to sentiment can lower shorted stock returns by a larger margin in extreme sentiment rather than mild sentiment. Specifically, in low sentiment, shorted stock returns are lowered not only by the average sentiment effect but also by the sentiment-based stock selection skills. In high sentiment, however, shorted stock returns are heightened by the average sentiment effect but lowered by the sentiment-based stock selection skills. The latter effect offsets the former; thus, shorted stock returns may not increase in investor sentiment level, particularly in high sentiment. In addition, the difference between returns on shorted and non-shorted stocks shows a negative and inverse U-shaped pattern across the sentiment levels.

We also consider margin traders who are speculators with positive beliefs about stocks and who purchase stocks with borrowed money. Thus, short sellers and margin traders hold opposing views of stocks. We assess the superiority of short sellers' ability to analyze firm-specific sentiment relative to that of margin traders.

Our analysis needs an index to measure unobservable sentiment, which differs from observable information. It further necessitates a firm-specific investor sentiment index rather than a market-wide sentiment index (e.g., Baker and Wurgler, 2006). Berkman et al. (2012) argue that retail investors tend to place their orders overnight, whereas institutional investors concentrate their trades on the opening hours of stock markets to lower trading costs and reduce risk by trading against the herd of irrational individual investors. Following high-sentiment days, sentiment-driven retail investors create upward price pressure, especially at the next open price. Aboody et al. (2018) show that overnight returns possess characteristics that would be expected of a firm-level sentiment measure and thus overnight returns can serve as a measure of firm-specific investor sentiment for the U.S. stock market. Weissofner and Wessels (2020) provide international stock market evidence on overnight returns as a firm-level investor sentiment measure. Lou et al. (2019) decompose abnormal profits of firm characteristic-based portfolios into their overnight and intraday components. They document that trading profits are not evenly distributed but concentrated either intraday or overnight. They also show that the difference between market-wide overnight and intraday returns, dubbed the "tug of war", possesses predictive powers for future trading profits. Kim and Suh (2021) argue that different times during the trading day will correspond to differing levels of participation from uninformed investors and institutional arbitrageurs, which could be more effectively, measured using both overnight and intraday returns rather than just overnight returns. They propose the difference between firm-level overnight and intraday returns as a firm-level investor sentiment measure. This study follows Kim and Suh (2021) and utilizes the difference between overnight and intraday returns to measure investor sentiment.

For our analysis, we use Korean stock market data for the following reasons. Lehmann (1990) argues that systematic changes in fundamental valuation should not occur over short time intervals like a week in efficient markets and that examining short-term returns can distinguish between changes in fundamental valuation and market inefficiency. Barber et al. (2009) also use a weekly horizon to analyze the effects of retail trades on stock returns. Several studies use overnight returns to measure sentiment and analyze the effect of sentiment on stock returns over a weekly horizon (e.g., Aboody et al., 2018; Weissofner and Wessels, 2020; Kim and Suh, 2021). Following prior studies, we choose a weekly horizon for our analysis. While U.S. short interest data are available only semi-monthly, daily short interest data are available in the Korean stock market. More importantly, margin traders and short sellers not only hold opposing views on stocks but also belong to different investor groups in the Korean stock market. Specifically, short sellers are mostly institutional investors, whereas margin traders are retail investors. The Korean stock market data not only allow us to assess which of the two types of investors possesses the skills to analyze firm-specific sentiment but also to investigate which type of investors shows a superior skill and whether the superiority is attributable to investor group characteristics or not. By contrast, comprehensive public information about margin trading is, to our knowledge, not available in the US stock

market.

The main findings are as follows. First, the firm-specific sentiment index that uses overnight returns minus intraday returns is an appropriate measure of investor sentiment in the Korean stock market. Second, we sort stocks into firm-specific sentiment and short interest levels. We find evidence supporting the hypothesis that short sellers are skilled at analyzing firm-specific sentiment. Third, we find that the economic value of the firm-specific sentiment is sizable for shorted stocks and firm characteristics are associated with the sentiment effect on shorted stock returns. The hypothesis is particularly pronounced for stocks with a high return volatility, low profitability, high price-to-earnings ratio, high momentum stocks, and a low book-to-market (BM) ratio. Fourth, we find no evidence to support the hypothesis that margin traders are skilled at analyzing firm-specific sentiment. Short sellers possess superior skills compared to margin traders.

This study contributes to the literature in the following ways. Existing studies identify the information that short sellers possess. Specifically, several studies demonstrate that short sellers' long-term excess returns are attributable to their ability to analyze public information (e.g., Dechow et al., 2001; Daske et al., 2006; Engelberg et al., 2012). Wang et al. (2017) support the idea that individual short sellers possess the skills to exploit short-term price reversals and process public information. By contrast, Christophe et al. (2004) attribute the excess returns earned by short sellers to their private information: announcements of negative earnings surprises. Desai et al. (2006) find that short sellers can distinguish firms with questionable earnings reports and increase their short positions ahead of earnings restatement announcements. Lamont and Stein (2004) find evidence that short sellers exploit momentum-based or trend-chasing strategies whereas Curtis and Fargher (2014) find evidence that short sellers trade using a value-based strategy. Others investigate markets in the US, Korea, Brazil, and Taiwan, and argue that short sellers can earn excess returns by using uninformed investors' trading preferences and behavior (e.g., Kelley and Tetlock, 2017; Wang et al., 2017; Chague et al., 2019; Tsai et al., 2021). This study extends the literature by providing evidence that short sellers possess the novel skill to analyze firm-specific sentiment efficiently. Moreover, this study argues that the effect of firm-specific sentiment on shorted stock returns is non-linear and pronounced in extreme sentiment rather than mild sentiment.

In addition, this study extends the literature on firm-specific sentiment (e.g., Aboody et al., 2018; Lou et al. 2019; Weissofner and Wessels, 2020; Kim and Suh, 2021). Firm-specific sentiment helps to better analyze the varying effects of sentiment across stocks. This study hypothesizes short sellers' superior skills to analyze firm-specific investor sentiment and shows a novel relationship between firm-specific investor sentiment and shorted stock returns.

The remainder of this study is organized as follows. Section 2 develops hypotheses relevant to our analysis. Section 3 explains the characteristics of short selling in the Korean stock market. Section 4 describes the data used in this analysis. Section 5

presents the main empirical analysis results on the effect of sentiment on shorted stock returns. Section 6 presents additional analyses that complement the main findings. Finally, Section 7 concludes the study.

2. HYPOTHESIS DEVELOPMENT

In this section, we develop a hypothesis about the relationship between firm-specific sentiment and shorted stock returns. To this end, we first make the following assumptions:

Assumptions

1. (Informed short sellers.) Short sellers are informed traders; shorted stock returns are negative and the return difference between shorted and non-shorted stocks is negative.
2. (Average effect of sentiment.) Investor sentiment is positively related to future stock returns on average.
3. (Differential effect of sentiment.) The effect of sentiment on future return not only varies in time and across stocks but also is more pronounced in extreme sentiment rather than mild sentiment.
4. (Short sellers' sentiment-analyzing ability.) Short sellers possess the sentiment-analyzing ability and can use it to choose stocks to be short.

Assumptions 1 and 2 are well documented in the literature. It would be reasonable to make Assumption 3 that investor sentiment exhibits differential effects on future stock returns.

We combine Assumptions 1 to 3 with Assumption 4 of short sellers' sentiment-analyzing ability. As investor sentiment exerts more pronounced effects in extreme sentiment rather than mild sentiment, short sellers are more attentive to extreme sentiment. Short sellers who possess the sentiment-analyzing ability can use it to choose stocks to be short, particularly in extreme sentiment. Their sentiment-based stock selection skills lower shorted stock returns by a larger margin in extreme sentiment rather than mild sentiment. More specifically, in low sentiment, shorted stock returns are lowered not only by the average sentiment effect but also by the sentiment-based stock selection skills. In high sentiment, however, shorted stock returns are heightened by the average sentiment effect but lowered by the sentiment-based stock selection skills. The latter effect offsets the former; thus, shorted stock returns may not increase in investor sentiment level, particularly in high sentiment. The following null hypothesis summarizes the argument:

H1. *If Assumptions 1 to 4 hold, then shorted stock returns may not increase in*

investor sentiment level particularly in high sentiment and the difference between returns on shorted and non-shorted stocks shows a negative and inverse U-shaped pattern across the sentiment levels.

If short sellers do not possess the sentiment-analyzing ability, they do not pay attention to the differential effect of sentiment. We combine assumptions 1 and 2 with the assumption that short sellers do not possess such ability and develop the following alternative hypothesis:

H1a. *If Assumptions 1 and 2 hold and short sellers do not possess the sentiment-analyzing ability, then shorted stock returns increase in investor sentiment level and the return difference between shorted and non-shorted stocks does not show an inverse U-shaped pattern across investor sentiment levels.*

Prior studies argue that a high investor sentiment causes an upward pressure on stock prices. Short selling constraints and limits to arbitrage are major factors in the relationship between sentiment and stock returns.[1] Unlike prior studies, hypothesis (H1) offers a novel relationship between sentiment and stock returns. Specifically, the hypothesis differentiates between shorted and non-shorted stocks, and argues that the sentiment effects on returns on these two differ from each other.

3. SHORT SELLING IN THE KOREAN STOCK MARKET

The introduction of loan transaction system and stock loan system allowed individual investors to engage in short selling in the Korean stock market in 1969. Institutional investors and foreign investors were allowed to undertake short sale transactions in September 1996 and July 1998, respectively. The up-tick rule, which does not allow ordering short sales at a price lower than the previous selling price, was introduced in the Korean stock market in 1996. The institutional (individual) short sellers were required to cover their short positions within six (three) months, but security lenders had the right to recall the shares in five days after lending. The principal security lenders in Korea are pension funds, banks, insurance companies and asset management companies. For institutional and foreign investors, the collateral values were required to be 90% to 110% of the market value of the borrowed stocks.

The Financial Supervisory Service (FSS) of Korea prohibited short selling without borrowing stocks, that is, “naked short selling”. To mitigate stock market crashes due to the financial crisis of 2008, the FSS prohibited short selling any stocks that were listed on Korea Composite Stock Price Index (KOSPI) and Korea Securities Dealers

[1] See, for example, Shleifer and Summers (1990).

Automated Quotation (KOSDAQ) markets from October 1, 2008 to May 31, 2009. During this period, the FSS introduced stricter short selling rules regarding intensively shorted stocks, collateral requirements, and disclosures. The FSS applied the "cooling period system" that prohibits a stock from being sold short for ten days when the shorted amount for the given stock exceeds 5% (3%) of the total trading amount on the KOSPI (KOSDAQ) market during the most recent 20 days. The collateral requirement increased to 140% of the market value of borrowed stocks. Since June 23, 2008, the Korea Exchange (KRX) is required to disclose daily the list of shares sold short together with the amount sold short.

The Financial Services Commission (FSC) imposed a ban on short selling for all KOSPI and KOSDAQ stocks from March 13, 2020 to May 2, 2021 to stabilize the market impact triggered by the Covid-19 pandemic. The financial regulator partially lifted the ban, and allowed short selling for only 350 big stocks belonging to the KOSPI200 index or the KOSDAQ150 index from May 3, 2021. In addition to this partial permission for short selling, the FSC also took measures to promote short selling by individual investors and imposed tougher regulations on illegal short selling activities. Individual investors can now borrow stocks more easily, and their stock borrowings are guaranteed for 60 days.

Table 1. Short Selling and Stock Transaction by Investors in the Korean Stock Market

		2018	2019	1-1-2020～3-13-2020	5-3-2021～9-17-2021
A. Short selling	Foreign	67.20%	62.80%	55.10%	76.00%
	Institutional	31.90%	36.10%	43.70%	22.10%
	Individual	0.80%	1.10%	1.20%	1.90%
B. Stock transaction	Foreign	27.10%	28.40%	25.10%	19.20%
	Institutional	20.70%	23.10%	22.80%	16.00%
	Individual	51.00%	47.50%	50.90%	63.90%
	Other	1.20%	1.00%	1.30%	1.00%

Notes: This table shows the ratio of short selling by investor groups to the total short selling amounts in Panel A. Panel B shows the ratio of stock transactions by investor groups to the total stock transaction amounts.
Source: The Financial Supervisory Committee of Korea (press release, September 24, 2021) and the Economic Statistics System by the Bank of Korea.

A distinguished feature of the Korean stock market is its composition of market participants. Table 1 shows investors' short selling and stock trading activities. Domestic and foreign institutional investors dominate short selling transactions in the Korean stock market; the share of retail investors is only one or two percent in short selling

activities, which is similar to the case of the US market (Boehmer et al., 2008). However, individual investors play a major role in the overall stock transactions, contributing roughly 50% of stock transactions, whereas foreign and domestic institutional investors hold the rest, which contrasts with advanced markets in which institutional investors are major participants (Blume and Keim, 2012).

4. DATA

We collect the data for our analysis from FnGuide. The short selling data of the Korean stock market we use in the analysis spans the period from June 30, 2016, to March 6, 2020. Since August 30, 2012, investors whose net short position is 0.1% or more of the total outstanding shares for each stock are required to report the details of their short interest to the FSS. However, the data on short interest ratio (short position as a fraction of shares outstanding) are publicly available from June 30, 2016. Therefore, we consider the period from June 30, 2016 to March 6, 2020, the latter being announcement date of the Covid-19 pandemic-related ban on short sales.[2]

5. EMPIRICAL ANALYSIS

This section provides the main results of the empirical analysis of a wide range of questions.

5.1. Investor Sentiments

Following Aboody et al. (2018) and Kim and Suh (2021), we calculate daily, overnight, and intraday returns as the difference between closing and closing (CTC) stock prices, closing and opening prices (CTO) and opening and closing prices (OTC), respectively. Specifically,

$$CTC_{i,d} = \frac{C_{i,d}}{C_{i,d-1}} - 1, \tag{1}$$

$$CTO_{i,d} = \frac{O_{i,d}}{C_{i,d-1}} - 1, \tag{2}$$

$$OTC_{i,d} = \frac{C_{i,d}}{O_{i,d-1}} - 1, \tag{3}$$

[2] We used DataGuide5 system for data retrieval from FnGuide (www.fnguide.com).

where $O_{i,d}$ and $C_{i,d}$ are the opening and closing stock prices for a firm i and day d, respectively. For all opening and closing prices, we use adjusted prices after accounting for corporate actions such as stock splits, stock dividends, and cash dividends. We did not compute the returns for days for which opening or closing price data were not present in our data.

Note that daily returns can be expressed as the product of overnight and intraday returns as follows:

$$CTC_{i,dt} = \left(1 + CTO_{i,d}\right)\left(1 + OTC_{i,d}\right) - 1.$$

We obtain weekly CTO and OTC returns for week w by averaging the corresponding daily returns from Monday to Friday in week w and multiplying them by 5.

Finally, CMO denotes the firm-specific investor sentiment index, which is measured as the difference between overnight returns (CTO) and intraday returns (OTC) as follows:

$$CMO_{i,d} = CTO_{i,d} - OTC_{i,d}. \quad (4)$$

Similarly, we define $CMO_{i,w}$ as the difference between $CTO_{i,w}$ and $OTC_{i,w}$ as follows:

$$CMO_{i,w} = CTO_{i,w} - OTC_{i,w}. \quad (5)$$

We use $CMO_{i,w}$ as a weekly proxy for firm-specific investor sentiment. For each week w, we sort all stocks in an ascending order according to their weekly CMO and divide them into deciles. Table 2 shows the descriptive statistics for the stocks in each weekly CMO decile. In addition to reporting the average weekly CTO and OTC, Table 2 presents the descriptive statistics on the average weekly return, book-to-market ratio, and the momentum. The return for week w is the compounded daily returns from Monday to Friday in week w. The book-to-market ratio of a firm is the equity book value of the company divided by its equity market value, calculated at the end of the preceding fiscal quarter. Momentum is defined as the firm's cumulative return from $t-12$ to $t-1$, where t is the month in which week w falls.

The average weekly CMO ranges from -3.04% in the lowest decile to 3.00% in the highest decile. Intraday returns reverse across deciles, consistent with the results of the previous studies. The average weekly CTO monotonically rises from -0.70% to 1.05% in accordance with the CMO deciles. By contrast, the average OTC monotonically decreases from 2.34% to -1.95% with the CMO deciles. For nine deciles out of 10, the average weekly CTO and OTC show opposite signs. The average weekly return ranges from 7.85% in the lowest decile to -4.45% in the highest decile and has the same sign as the average weekly OTC. The magnitude of the average weekly return is greater than

that of the average weekly OTC. This implies that compared to CTO, OTC has a greater impact on CTC. Lastly, the book-to-market ratio displays an inverse U-shaped pattern, whereas the momentum displays a U-shaped pattern, reaching its maximum and minimum, respectively, at the fifth decile.

Table 2. Descriptive Statistics of Investor Sentiment Index

Decile of weekly CMO		1 (Lowest)	2	3	4	5	6	7	8	9	10 (Highest)
Average weekly	CMO	-3.04	-1.08	-0.6	-0.28	-0.01	0.25	0.54	0.88	1.37	3.00
	CTO	-0.70	-0.26	-0.17	-0.09	-0.02	0.05	0.13	0.23	0.38	1.05
	OTC	2.34	0.81	0.44	0.19	-0.01	-0.20	-0.40	-0.65	-0.99	-1.95
	Return	7.85	2.64	1.28	0.45	-0.22	-0.78	-1.32	-2.03	-2.97	-4.45
Average	Return vol.	3.25	2.77	2.64	2.61	2.60	2.64	2.71	2.83	3.04	3.52
	Momentum	10.30	3.87	1.32	0.98	0.81	1.09	2.05	3.95	7.58	17.48
	Size	6.22	9.75	9.61	9.76	9.16	9.42	9.68	9.17	7.17	3.65
	Age	26.88	29.5	30.08	30.18	30.16	30.34	30.12	29.44	28.58	26.58
	ROE	-8.62	-0.69	-0.45	-1.13	-1.96	-0.94	-0.28	-0.79	-3.24	-10.79
	PER	130.24	118.32	85.33	76.06	99.24	99.81	77.44	78.16	98.65	125.16
	BM	0.86	1.09	1.15	1.17	1.17	1.16	1.15	1.09	1.01	0.83

Notes: This table shows the sample descriptive statistics for the variables by decile ranking of the average weekly CMO from June 30, 2016, to March 6, 2020. The average weekly CMO (CTO or OTC) is multiplied by five, the average of CMO (CTO or OTC) at the end of Monday in week $w-1$ to the end of Friday in week w. Average weekly return is multiplied by 5, the average of the total return from the end of Monday in week $w-1$ to the end of Friday in week w. Average return volatility is the average of the standard deviation of daily stock returns from month $t-12$ to month $t-1$, where t is the month in which week w falls. The average momentum is the average of monthly stock returns over months $t-12$ to $t-1$, where t is the month in which week w falls. Average size is the average market value of equity in the previous month. The average age is the average number of years since the firm was founded, calculated as of the previous month. The average ROE is the average return on equity of a firm. The average PER is the average price-to-earnings ratio of a firm. The average book-to-market (BM) ratio is the average book value at the end of the previous fiscal quarter divided by the market value of equity at the end of the previous fiscal quarter.

Table 2 also provides summary statistics on the five proxies for the degree of difficulty into valuing firms: firm size, stock return volatility, firm age, profitability, and price-to-earnings ratio (PER). Firms with a higher volatility, smaller size, younger age, lower profitability, and higher valuations are harder to value. Firm size is measured as a firm's market equity value at the end of the previous month. Return volatility is measured as the standard deviation of a stock's daily returns from months $t-12$ to

$t-1$. Firm age is the number of years since the firm was established up to the end of the previous month. We use a firm's return on equity (ROE) as a proxy for profitability, measured as the ratio of net income to shareholders' equity. The average PER is measured as the ratio of the market equity value to the firm's earnings per share. Return volatility and PER show a U-shaped pattern, whereas firm size, firm age, and ROE show inverse U-shaped patterns. These results are largely consistent with those of the previous studies.

Following Aboody et al. (2018) and Kim and Suh (2021), we conduct additional tests to determine whether the CMO is an appropriate measure of firm-specific investor sentiment. In particular, we examine whether CMO persists over a short-term period; short-term persistence is stronger among stocks that are difficult to value, and firms with a high CMO under-perform firms with a low CMO over the long-term.

We construct ten groups according to the CMO for week w and calculate the average weekly CMO for weeks $w+1$ to $w+4$ for each decile to examine the CMO's short-term persistence. If the CMO is an appropriate measure of the sentiment, it will persist over the short term. Table A1 (of the Internet Appendix3) reports the short-term persistence of the CMO. The average CMOs in weeks $w+1$ to $w+4$ increase monotonically across the deciles. The average CMO in week $w+1$ is -0.35% in the lowest decile of week w and 0.49% in the highest decile of the same week. The difference in return between deciles 1 and 10 is 0.84% and statistically significant. The average differences between CMOs in the highest and lowest deciles in weeks $w+2$ to $w+4$ are also positive and statistically significant.

Sentiment will have a great impact on the stock returns of firms that are harder to value objectively (Baker and Wurgler, 2006; Seybert and Yang, 2012). If the CMO truly reflects the firm-specific investor sentiment, we should find that short-term CMO persistence is stronger for firms that are more difficult to value. We use the following five measures as proxies for the extent to which a firm is difficult to value: stock return volatility, firm size, firm age, ROE, and PER. Firms that are more volatile, smaller, younger, less profitable, and have a higher price-to-earnings ratio are harder to value. We rank stocks in an ascending order for each week w for each measure and divide them into quartiles. We then rank the stocks in an ascending order according to the CMO in week w in each quartile and then divide them into deciles. We calculate the average CMO for the highest and lowest of these deciles as well as the difference between these two deciles during each of the weeks $w+1$ to $w+4$. Table A2 (of the Internet Appendix) shows the results for each of the five measures. The results are reported only for week $w+1$ for the sake of parsimony. The difference between the highest and lowest CMO deciles for the average CMO in week $w+1$ increases monotonically with the firm-valuing difficulty for each of the hard-to-value measures. The results for weeks $w+2$ to $w+4$ are qualitatively similar.

According to Baker and Wurgler (2006), stocks that attract speculators during

[3] The Internet Appendix link: https://jed.cau.ac.kr/archives/48-4/48-4-4-Appendix.pdf

periods of a high market-wide sentiment tend to underperform over the following twelve months. A high sentiment may drive short-term overpricing, but this mispricing will reverse in the long term. We use monthly returns to test long-term return reversals. We compute the average daily CMO for all years for the month of December and sort all firms on average daily CMO, with the tenth decile being the highest. We then construct three equal-weight portfolios: the first one is long in the first decile stocks, the second one is long in the tenth decile stocks, and the third one is long in the first decile stocks and short in the tenth decile stocks. We calculate the cumulative buy-and-hold return for each portfolio for each of the subsequent twelve months. Each portfolio's average monthly abnormal return is given by intercept, α, from the following monthly time-series regression:

$$R_t - R_{ft} = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WML_t + \varepsilon_t, \quad (6)$$

where R_t is the portfolio return during month t; R_{ft} is the risk-free rate in month t; R_{mt} is the return on the market index in month t; SMB is the return on the portfolio of small stocks minus the return on the portfolio of big stocks; HML is the return on the portfolio of stocks of high book-to-market ratios minus the return on the portfolio of stocks with low book-to-market ratios; and WML is the return on the portfolio of stocks with high recent returns minus the return on the portfolio of stocks with low recent returns.

We report the results of the monthly time-series regression (6) in Table A3 (of the Internet Appendix). Over twelve months following the period of high sentiment, after risk adjustments, stocks in the highest decile of the CMO significantly under-perform, compared to those in the lowest decile. A portfolio that goes long in stocks in the lowest CMO decile and short in stocks in the highest CMO decile earns a positive and significant (at the 10% level) average monthly abnormal return of 0.60% (7.0% per annum). These results suggest that firms with the highest short-term CMO are overpriced compared to those with the lowest short-term CMO, and that such mispricing is reverted over the following twelve months. This further supports the argument that the CMO is a good measure of the firm-specific investor sentiment.

5.2. Shorted Stocks

To characterize shorted stocks, Table 3 presents descriptive statistics of the shorted stocks in the Korean stock market. Shorted stocks are classified according to the short interest ratio (SIR), which is the ratio of short interest to outstanding shares. The average number of shorted stocks during the sample period is 1,155, 537, and 298 for an SIR greater than 0%, 0.5%, and 1%, respectively, while the average number of all stocks is 1,949. Some firm characteristics (such as average weekly return volatility and price-to-earnings ratio) increase with the SIR, while others (such as firm age and book-to-market ratio) decrease with the SIR. The average firm size, momentum, and

profitability do not exhibit any conspicuous patterns across the SIR.

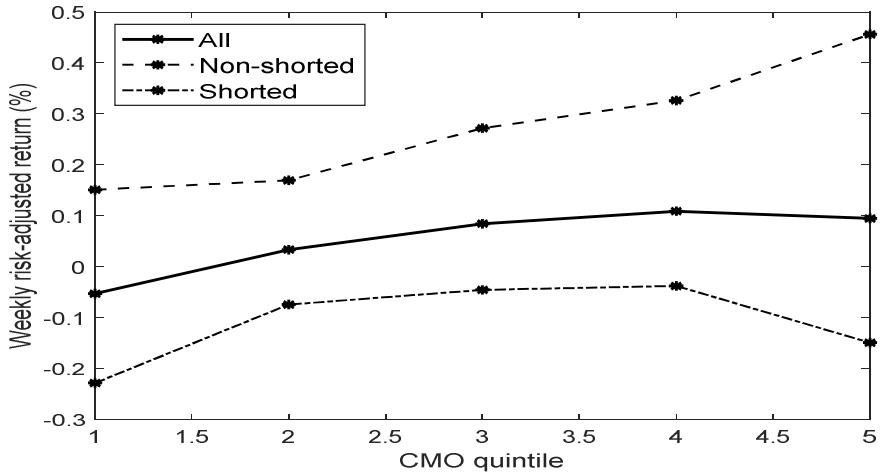
Table 3. Descriptive Statistics of Shorted Stocks

	All stocks	SIR > 0%	SIR > 0.5%	SIR > 1%
Avg. weekly no. of stocks	1949	1155	537	298
Avg. weekly return (%)	0.04	0.07	0.03	0.04
Avg.return volatility (%)	2.86	3.04	3.35	3.40
Avg. momentum (%)	4.97	6.23	7.38	6.99
Avg. size	8.39	13.50	9.81	11.44
Avg. age	29.21	29.53	28.22	27.97
Avg. ROE	-2.77	-5.03	-10.98	-10.86
Avg. PER	97.57	98.07	127.53	136.66
Avg. BM	1.07	0.92	0.71	0.66

Notes: This table shows the sample descriptive statistics for both all stocks, and shorted stocks that are classified according to the level of the short interest ratio (SIR) from June 30, 2016, to March 6, 2020. Average weekly return is the average of the total return from the end of Monday in week $w-1$ to the end of Friday in week w. Average return volatility is the average of the standard deviation of daily stock returns over months $t-12$ to $t-1$, where t is the month in which week w falls. The average momentum is the average of monthly stock returns over months $t-12$ to $t-1$, where t is the month in which week w falls. Average size is the average market value of equity in the previous month. The average age is the average number of years since the firm was founded, calculated as of the previous month. The average ROE is the average return on equity of a firm. The average PER is the average price-to-earnings ratio of a firm. The average book-to-market (BM) ratio is the average book value at the end of the previous fiscal quarter divided by the market value of equity at the end of the previous fiscal quarter.

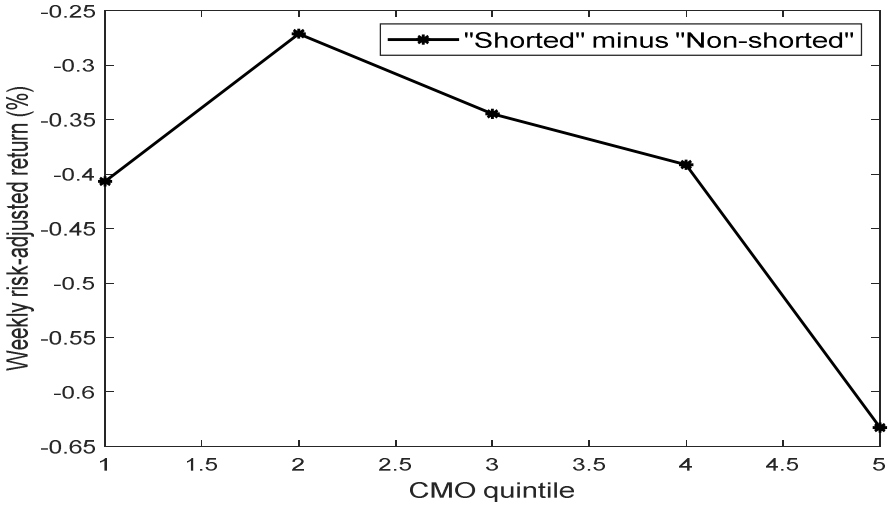
5.3. Portfolio Based on Investor Sentiment

We construct weekly equal-weight quintile portfolios based on the CMO in week w. Figure 1 shows the average risk-adjusted returns of the CMO-sorted quintile portfolios for week $w+1$ using all, non-shorted, and shorted stocks. Here, shorted stocks refer to stocks with a positive SIR. We use the Fama-French-Carhart four factor model for risk adjustment. Table A4 (of the Internet Appendix) provides risk-adjusted returns and summary statistics of the CMO-sorted quintile portfolios using all, non-shorted as well as shorted stocks. Table A4 shows the results for shorted stocks, referring to stocks with an SIR higher than 0%, 0.5%, or 1%. Figure 2 shows the average risk-adjusted return difference for week w+1 between the equal-weight portfolios of shorted and non-shorted stocks for each CMO quintile. Table A5 (of the Internet Appendix) presents the risk-adjusted returns and summary statistics of the CMO-sorted quintile portfolio return difference between shorted and non-shorted stocks.



Notes: This figure shows the weekly average risk-adjusted returns of the CMO-sorted quintile portfolios using all, non-shorted and shorted stocks. Shorted stocks refer to stocks with a positive short interest ratio (SIR). We used the Fama-French-Carhart four-factor model for risk adjustment.

Figure 1. Weekly Risk-Adjusted Returns of CMO-Sorted Equal-Weight Portfolios



Notes: This figure shows the weekly average risk-adjusted return difference between the CMO-sorted equal-weight portfolios of shorted and non-shorted stocks. Shorted stocks refer to stocks with a positive short interest ratio (SIR). We used the Fama-French-Carhart four-factor model for risk adjustment.

Figure 2. Weekly Risk-Adjusted Return Difference between CMO Sorted Equal-Weight Portfolios of Shorted Stocks and Those of Non-Shorted Stocks

We find that CMO-sorted quintile portfolio returns tend to increase slightly with the CMO level for all stocks, whereas the patterns of returns on shorted and non-shorted stocks differ significantly. The risk-adjusted return on non-shorted stocks is significantly positive and tends to increase with the CMO level, from a weekly return of 0.15% (the lowest CMO quintile) to 0.46% (the highest CMO quintile). By contrast, the risk-adjusted return of shorted stocks (with SIR>0%) shows a negative and inverse U-shaped pattern along the CMO level: -0.23%, -0.08%, -0.05%, -0.04%, and -0.15% from the first to the fifth CMO quintile. The risk-adjusted return differences between shorted and non-shorted stocks are significantly negative and exhibit a pattern similar to an inverse U-shape: their values are -0.41%, -0.27%, -0.35%, -0.39%, and -0.63% from the first to the fifth CMO quintile. This result supports hypothesis (H1) that shorted stock returns are lower than non-shorted stock returns, particularly for an extreme sentiment rather than a mild sentiment. This result also holds for shorted stocks with SIR higher than 0.5% or 1%.

Table 4. Weekly Return Difference between Shorted and Non-Shorted Matched Stocks Across CMO Quintiles

Matching firms	CMO quintile	Mean		Median		
		return (%)	(p-val)	return (%)	(p-val)	
					Sign test	Wilcoxon test
$Size \times BM$	1	**-0.32**	(0.00)	**-0.35**	(0.00)	(0.00)
	2	-0.13	(-0.05)	-0.04	(-0.07)	(-0.02)
	3	-0.11	(-0.10)	**-0.01**	(-0.04)	(-0.03)
	4	**-0.19**	(0.00)	**-0.23**	(0.00)	(0.00)
	5	**-0.36**	(0.00)	**-0.31**	(0.00)	(0.00)
$Size \times MOM$	1	**-0.23**	(-0.01)	**-0.34**	(0.00)	(0.00)
	2	-0.12	(-0.07)	**-0.11**	(0.00)	(0.00)
	3	**-0.21**	(0.00)	**-0.16**	(0.00)	(0.00)
	4	-0.17	(-0.01)	**-0.24**	(0.00)	(0.00)
	5	**-0.38**	(0.00)	**-0.38**	(0.00)	(0.00)

Notes: This table shows the sample descriptive statistics for both all stocks, and shorted stocks that are classified according to the level of the short interest ratio (SIR) from June 30, 2016, to March 6, 2020. Average weekly return is the average of the total return from the end of Monday This table shows the weekly average return difference between shorted and non-shorted matched stocks across CMO quintiles. To match firm characteristics, stocks are assigned to one of the 80 groups combining the CMO quintile, size quartile, and BM quartile (or momentum quartile). Within each of the 80 groups, the shorted and non-shorted stocks belonging to the same group were randomly matched. The mean and median difference test results are presented. The sign and Wilcoxon signed-rank tests were used for the median difference test. Bold numbers indicate statistical significance at a 5% level.

5.4. Matching-Firm Methodology

We employ the matching-firm methodology to account for differences in firm characteristics between shorted and non-shorted stocks. To match firm characteristics, stocks are assigned into one of the 80 groups combining the CMO quintile, size quartile, and BM quartile (or momentum quartile). Within each of the 80 groups, the shorted and non-shorted stocks belonging to the same group are randomly matched. The number of matched stock pairs in each group equals the minimum number of shorted and non-shorted stocks in the group. Table 4 shows the weekly average return difference between shorted and non-shorted matched stocks across the CMO quintiles and provides the mean and median difference test results. While the return difference shows an inverse U-shaped pattern for the $Size \times BM$ matched portfolios, it does not for the $Size \times MOM$ matched portfolios. However, the result shows that the return difference between shorted and non-shorted matched stocks is not only less but also significantly negative for an extreme sentiment. This implies that the result is consistent with hypothesis (H1), after controlling for firm characteristics.

5.5. Panel Regression

We also conduct a panel regression to confirm the above portfolio analysis results. The panel regression Model (1) is specified as follows:

Model (1):

$$r_{i,w+1} = \alpha_i + \beta_1 SIRdum_{i,w} + \beta_3 CMO_{i,w} + \beta_4 SIRdum_{i,w} \times CMO_{i,w} + \beta_7 CMO_{i,w}^2 + \beta_8 SIRdum_{i,w} \times CMO_{i,w}^2 + \gamma \ \mathrm{X}_{i,w} + \varepsilon_{i,w+1}, \quad (7)$$

where $r_{i,w+1}$ indicates the return of stock i in week $w+1$, $CMO_{i,w}$ is the CMO of stock i in week w, $SIRdum_{i,w}$ denotes a dummy variable that takes the value of one for a shorted stock (SIR>0%) and zero otherwise. Panel regression is specified with fixed effects by including dummy variables for individual stocks and week dummy variables. $\mathrm{X}_{i,w}$ indicates a vector of control variables including market return and several firm-characteristics variables such as size (market capitalization), price-to-book value ratio, idiosyncratic risk (measured by the standard deviation of residuals from the regression of excess returns on the Fama-French three factors), idiosyncratic skewness (calculated as skewness of residuals from the regression of excess returns on the market factor and squared market factor), the highest five daily returns, and the previous 4-week turnover.

Table 5 shows the results on the panel regression Model (1). The coefficient of the interaction between $SIRdum$ and CMO is significantly negative, which implies that shorted stock returns tend to be lower than non-shorted stock returns for every CMO level. Moreover, the significantly negative coefficient of the interaction between $SIRdum$ and CMO^2 suggests that this tendency is stronger for extreme CMO levels.

This panel regression result supports hypothesis (H1) at the individual stock level, after controlling for market return and firm characteristics.

Table 5. Panel Regression of Stock Returns

Explanatory variables	Coef.	Dependent variable: $Return_{i,w+1}$ (1) Est.	(1) t-val	(2) Est.	(2) t-val	(3) Est.	(3) t-val
$_{i,w}$	β_1	**-0.00**	(-9.08)			**-0.00**	(-9.07)
$n_{i,w}$	β_2			0.00	(0.46)	0.00	(0.87)
	β_3	**0.13**	(12.70)	0.09	(9.23)	**0.12**	(-8.92)
$_{i,w} \times CMO$	β_4	**-0.06**	(-4.29)			**-0.06**	(-2.75)
$n_{i,w} \times CMO_{i,w}$	β_5			0.00	(0.18)	0.03	(1.36)
$SIRdum_{i,w} \times MTRdum_{i,w} \times CMO_{i,w}$	β_6					-0.01	(-0.46)
	$\beta_4 + \beta_6$					**-0.07**	(-3.66)
	$\beta_5 + \beta_6$					0.02	(0.77)
$CMO_{i,w}^2$	β_7	**-0.84**	(-7.91)	-1.10	(-10.40)	**-0.87**	(-7.49)
$m_{i,w} \times CMO_{i,w}^2$	β_8	**-0.95**	(-5.43)			**-1.11**	(-4.63)
$um_{i,w} \times CMO_{i,w}^2$	β_9			-0.12	(-0.70)	0.16	(0.64)
$m_{i,w} \times MTRdum_{i,w} \times CMO_{i,w}^2$	β_{10}					0.17	(0.52)
	$\beta_8 + \beta_{10}$					**-0.94**	(-3.63)
	$\beta_9 + \beta_{10}$					0.34	(1.41)
Control variables		Yes		Yes		Yes	
Stock fixed effect		Yes		Yes		Yes	
Week fixed effect		Yes		Yes		Yes	
N		344,915		344,915		344,915	
Adj. R^2 (%)		12.06		12.02		12.06	

Notes: This table shows the results of the panel regressions of individual stock returns on the lagged investor sentiment index (CMO), shorted stock dummy variable, margin-traded stock dummy variable, their interaction terms, and several control variables. The panel regressions are specified with fixed effects by including dummy variables for the individual stocks and week dummy variables. The shorted stock dummy variable ($SIRdum$) takes the value of one for a positive short interest ratio and zero otherwise. The margin-traded stock dummy variable ($MTRdum$) takes the value of one for margin trading ratios higher than 1% and zero otherwise. Control variables include market return and the following firm characteristic variables: size (market capitalization), price-to-book value ratio, idiosyncratic risk, idiosyncratic skewness, the highest five daily returns, and the previous 4-week turnover. Bold numbers indicate statistical significance at a 5% level.

6. ADDITIONAL ANALYSIS

To supplement the main results, we provide results from additional analyses in this section.

6.1. Sentiment Weight Portfolio

Our results suggest that an extreme sentiment affects stock returns significantly negatively. To further this result and estimate the economic value of the sentiment effect, we construct portfolios using sentiment-based weights and compare them with equal-weight portfolio. We may expect a lower portfolio return by putting more weight on higher-sentiment stocks and vice versa. The difference in performance between the two portfolios is an indication of the economic value of the sentiment effect on stock returns. The portfolios are formed in two ways: equal-weight (EW) and CMO-weight (CW). Under the CW strategy, the portfolio weights are proportional to $max\{0, CMO_{i,w}\}$ for the highest CMO quintile and $min\{0, CMO_{i,w}\}$ for the lowest CMO quintile, and their sum is normalized to be one.

Table 6 shows the performance in week $w+1$ of weekly portfolios that are formed using only shorted stocks (with SIR>0% for week w) belonging to the highest or the

Table 6. Performance Difference between Equal- and Sentiment-Weight Portfolios

	Highest CMO quintile			Lowest CMO quintile		
	EW	CW	CW-EW	EW	CW	CW-EW
Alpha	**-0.15**	**-0.27**	**-0.12**	**-0.23**	**-0.30**	**-0.07**
(t-value)	(-2.09)	(-2.76)	(-2.47)	(-3.69)	(-3.03)	(-1.09)
Mean return	-0.18	-0.31	**-0.12**	-0.26	-0.33	-0.07
(t-value)	(-0.82)	(-1.29)	(-2.39)	(-1.27)	(-1.44)	(-1.05)
Median return	0.08	-0.28	-0.17	0.08	-0.04	-0.08
S.d.	3.02	3.19	0.68	2.75	3.11	0.92
Skewness	-0.46	-0.18	0.36	-0.56	-0.12	0.89
Kurtosis	3.84	3.67	7.03	4.63	6.40	10.36
SR	-0.44	-0.69	-1.28	-0.68	-0.77	-0.56

Notes: This table shows the week $w+1$ performance of weekly portfolios that are formed using only shorted stocks with a positive short interest ratio (SIR) in week w. The portfolios are formed in two ways: equal-weight (EW) vs. CMO-weight (CW). Under the CW strategy, the portfolio weights are proportional to $max\{0, CMO_{i,w}\}$ for the highest CMO quintile and $min\{0, CMO_{i,w}\}$ for the lowest CMO quintile, and their sum is normalized to be one. Portfolio performance is presented using risk-adjusted alpha and summary statistics such as mean return, median return, standard deviation (S.d.), skewness, and kurtosis, and the Sharpe ratio (SR). We use the Fama-French-Carhart four factor model for risk adjustment. The t-values of risk-adjusted alphas are calculated using Newey and West (1987) standard errors. Bold numbers indicate statistical significance at a 5% level.

lowest CMO quintile. For the highest CMO quintile, the EW and CW portfolios show significantly negative weekly risk-adjusted returns of -0.15%, and -0.27%, respectively. The risk-adjusted return difference between the CW and EW portfolios is also significantly negative and sizable and equals to -0.12% (-6.1% per annum). For the lowest CMO quintile also, the EW and CW portfolios show significantly negative weekly risk-adjusted returns of -0.23%, and -0.30%, respectively. The risk-adjusted return difference between the CW and EW portfolios is negative but insignificant and equals to -0.07% (-3.6% per annum). This suggests that the result is not only consistent with hypothesis (H1) but also shows that the economic values of extreme sentiment are sizable.

6.2. Firm-Characteristics and Shorted Stock Returns

As Table 2 shows, the CMO may be correlated with some firm characteristics. In this subsection, we investigate the relationship between firm characteristics and the sentiment effect on shorted stock returns. We consider firm-characteristics such as return volatility, firm size, firm age, profitability (ROE), price-to-earnings ratio (PER), momentum (MOM), and book-to-market ratio (BM). Shorted stocks are double-sorted into quintiles based on the CMO in week w and into quartiles based on firm characteristics in week w.

Table 7 shows the average risk-adjusted return of double-sorts of shorted stocks in week $w+1$. The hypothesis (H1) holds for stocks with high return-volatility, low profitability, high price-to-earnings ratio, high momentum, and low book-to-market ratio.

This result is largely consistent with the correlation between CMO and firm characteristics as shown in Table 2. For example, extreme CMO deciles show relatively high return volatility; therefore, the hypothesis (H1) holds well for the highest return-volatility quartile in that it contains relatively more extreme CMOs than the other return-volatility quartiles do. The MOM, ROE, PER, and BM also show patterns similar to that of return volatility in Table 2. This result suggests that some firm characteristics may affect the sentiment effect on shorted stock returns via a correlation between sentiment and firm characteristics. In addition, sentiment will have a great impact on the stock returns of firms that are harder to value objectively (Baker and Wurgler, 2006; Seybert and Yang, 2012). If short sellers possess sentiment-analyzing ability, then they earn more profits from short sales of harder-to-value stocks with higher return-volatility, less profitability, and higher price-earning ratio.

6.3. Margin Trading

Margin traders, viewed as speculators with positive beliefs about stocks, purchase stocks with leverage by borrowing money from their brokerage companies. Thus, short sellers and margin traders hold opposing views of stocks. Furthermore, in the Korean stock market, margin traders are mostly retail investors, whereas short sellers are mostly

institutional investors. Margin traders and short sellers not only hold opposing views of stocks but also belong to different investor groups. Stocks are traded by different investor groups, and short sellers and margin traders can trade the same stock

Table 7. Performance Difference between Equal- and Sentiment-Weight Portfolios

Quartile	Quintile	Return volatility		Size		Age		ROE	
of char.	of CMO	Alpha	(t-val)	Alpha	(t-val)	Alpha	(t-val)	Alpha	(t-val)
1	1	**-0.31**	(-3.24)	0.32	(-1.40)	-0.34	(-1.59)	**-0.34**	(-2.79)
	2	-0.05	(-0.86)	0.11	(-0.71)	-0.16	(-0.86)	-0.15	(-1.62)
	3	**-0.14**	(-2.56)	0.27	(-1.73)	-0.05	(-0.23)	-0.11	(-1.18)
	4	0.01	(-0.09)	**0.37**	(-2.27)	-0.05	(-0.22)	**-0.21**	(-2.50)
	5	0.23	(-2.01)	0.08	(-0.60)	-0.15	(-0.63)	**-0.41**	(-3.95)
2	1	-0.15	(-1.50)	**-0.31**	(-2.72)	-0.10	(-0.42)	**-0.35**	(-3.16)
	2	-0.06	(-0.86)	0.01	(-0.14)	-0.11	(-0.51)	**-0.24**	(-3.34)
	3	-0.02	(-0.35)	0.00	(-0.04)	-0.02	(-0.09)	-0.04	(-0.48)
	4	0.01	(-0.12)	0.07	(-0.83)	0.00	(-0.01)	-0.13	(-1.80)
	5	0.08	(-0.88)	-0.04	(-0.30)	-0.24	(-0.99)	-0.15	(-1.34)
3	1	-0.01	(-0.09)	**-0.33**	(-3.92)	-0.25	(-1.11)	**-0.34**	(-3.40)
	2	-0.07	(-0.91)	**-0.18**	(-2.39)	-0.05	(-0.29)	0.01	(-0.09)
	3	-0.01	(-0.11)	-0.06	(-0.99)	-0.11	(-0.59)	**-0.15**	(-2.44)
	4	0.07	(-0.92)	**-0.15**	(-2.29)	-0.16	(-0.79)	-0.04	(-0.68)
	5	0.01	(-0.13)	**-0.25**	(-2.58)	-0.19	(-0.79)	0.09	(-0.84)
4	1	**-0.46**	(-3.91)	**-0.18**	(-2.01)	-0.30	(-1.41)	0.08	(-0.99)
	2	**-0.23**	(-2.16)	-0.12	(-1.78)	-0.10	(-0.55)	0.03	(-0.39)
	3	-0.04	(-0.36)	-0.11	(-1.77)	-0.09	(-0.53)	0.10	(-1.32)
	4	**-0.22**	(-2.46)	-0.03	(-0.49)	-0.01	(-0.07)	**0.25**	(-3.65)
	5	**-0.41**	(-3.74)	-0.13	(-1.41)	-0.14	(-0.61)	0.11	(-1.27)

Notes: This table shows the week $w + 1$ average risk-adjusted return of shorted stocks with a positive short interest ratio (SIR) in week w. Shorted stocks are double-sorted into quintiles based on CMO in week w and quartile of firm characteristics in week w, such as return volatility, firm size, firm age, profitability (ROE), price-to-earnings ratio (PER), momentum (MOM), and book-to-market ratio (BM). We used the Fama-French-Carhart four-factor model for risk adjustment. The t-values of the risk-adjusted alphas were calculated using Newey and West (1987) standard errors. Bold numbers indicate statistical significance at a 5% level.

Table 7. Performance Difference between Equal- and Sentiment-Weight Portfolios (cont')

Quartile	Quintile	PER		MOM		BM	
of char.	of CMO	Alpha	(t-val)	Alpha	(t-val)	Alpha	(t-val)
1	1	0.07	(-0.68)	**-0.27**	(-2.81)	**-0.35**	(-3.39)
	2	**0.14**	(-1.99)	-0.05	(-0.63)	-0.10	(-1.05)
	3	0.11	(-1.35)	0.01	(-0.22)	-0.01	(-0.07)
	4	**0.24**	(-2.97)	0.07	(-0.85)	-0.12	(-1.73)
	5	**0.29**	(-2.35)	0.14	(-1.42)	**-0.35**	(-3.62)
2	1	0.04	(-0.42)	**-0.22**	(-2.70)	-0.09	(-1.07)
	2	-0.05	(-0.63)	-0.05	(-0.81)	-0.04	(-0.55)
	3	0.01	(-0.12)	-0.07	(-1.06)	-0.05	(-0.82)
	4	0.18	(-2.77)	0.00	(-0.03)	0.03	(-0.46)
	5	0.20	(-1.90)	0.03	(-0.24)	-0.11	(-1.08)
3	1	**-0.34**	(-3.36)	**-0.21**	(-2.27)	**-0.23**	(-2.26)
	2	-0.10	(-1.36)	-0.04	(-0.63)	-0.12	(-1.87)
	3	-0.12	(-1.46)	-0.10	(-1.46)	-0.01	(-0.07)
	4	0.02	(-0.25)	-0.12	(-1.98)	0.00	(-0.04)
	5	-0.02	(-0.16)	-0.16	(-1.63)	0.12	(-1.17)
4	1	**-0.38**	(-2.89)	**-0.29**	(-2.70)	**-0.36**	(-3.44)
	2	-0.15	(-1.49)	**-0.20**	(-2.27)	-0.05	(-0.78)
	3	-0.06	(-0.64)	-0.05	(-0.58)	-0.07	(-0.95)
	4	**-0.19**	(-2.14)	-0.11	(-1.33)	0.04	(-0.53)
	5	-0.22	(-1.80)	**-0.37**	(-3.46)	0.04	(-0.40)

Notes: This table shows the week $w+1$ average risk-adjusted return of shorted stocks with a positive short interest ratio (SIR) in week w. Shorted stocks are double-sorted into quintiles based on CMO in week w and quartile of firm characteristics in week w, such as return volatility, firm size, firm age, profitability (ROE), price-to-earnings ratio (PER), momentum (MOM), and book-to-market ratio (BM). We used the Fama-French-Carhart four-factor model for risk adjustment. The t-values of the risk-adjusted alphas were calculated using Newey and West (1987) standard errors. Bold numbers indicate statistical significance at a 5% level.

simultaneously. In this subsection, we investigate whether margin traders can analyze sentiment skillfully at the individual stock level. In addition, we compare shorted stock returns with margin-traded stock returns and investigate which of these two types of investors possesses superior skills in analyzing sentiment.

6.3.1. Hypotheses

In the Korean stock market, short sellers and margin traders belong to different

investor groups. If both investor groups possess sentiment analyzing skills, then the sentiment-analyzing skill is hardly attributable to investor group characteristics. To investigate this point, we develop a hypothesis for margin traders. For that purpose, we make the following assumption:

Assumption: 5. (Margin traders' sentiment-analyzing ability) Margin traders possess the sentiment-analyzing ability and can use it to choose stocks to be long.

It is controversial whether margin traders are informed traders or not, thus we do not make that assumption. We combine Assumption 3 with Assumption 5 of margin traders' sentiment-analyzing ability. As investor sentiment exerts more pronounced effects in extreme sentiment rather than mild sentiment, margin traders pay more attention to extreme sentiment than mild sentiment. Margin traders who possess the sentiment-analyzing ability can use it to choose stocks to be long, particularly in extreme sentiment. Their sentiment-based stock selection skills heighten margin-traded stock returns by a larger margin in extreme sentiment rather than mild sentiment. More specifically, margin-traded stock returns are heightened by the sentiment-based stock selection skills in extreme sentiment while non-margin-traded stock returns are not. Therefore, the return difference between margin-traded stocks and non-margin-traded stocks will exhibit a U-shaped pattern across the sentiment levels. The following null hypothesis summarizes the argument:

H2. *If Assumptions 3 and 5 hold, then the return difference between margin-traded and non-margin-traded stocks shows a U-shaped pattern across the sentiment levels.*

If margin traders do not possess the sentiment-analyzing ability, they will not pay attention to the differential effect of sentiment. We assume that margin traders do not possess such ability and develop the following alternative hypothesis:

H2a. *If Assumption 5 does not hold, then the return difference between margin-traded and non-margin-traded stocks does not show a U-shaped pattern across the sentiment levels.*

We develop hypotheses H1 (H1a) and H2 (H2a) to answer whether short sellers and margin traders possess the skills to analyze firm-specific sentiment efficiently or not. Next, we investigate which of the two types of investors possesses superior skills in analyzing sentiment. While skillful short sellers exhibit an inverse U-shaped return difference across the sentiment levels (H1), skillful margin traders exhibit a U-shaped pattern (H2). Both opposite tendencies offset each other for shorted and margin-traded stocks. If short sellers possess superior skills in analyzing sentiment, then the inverse U-shaped pattern persists even for shorted and margin-traded stocks. To investigate whether short sellers possess superior skills in analyzing sentiment, we develop the

following hypothesis:

H3. *If short sellers possess superior skills in analyzing investor sentiment compared to margin traders, then shorted stock returns are lower than non-shorted stock returns for an extreme sentiment compared to a mild sentiment, and this holds true not only for non-margin trading but also for margin-traded stocks.*

We also develop a similar hypothesis for margin traders as follows:

H4. *If margin traders possess superior skills in analyzing investor sentiment compared to short sellers, then margin-traded stock returns are higher than non-margin trading stock returns for an extreme sentiment compared to a mild sentiment, and this holds true not only for non-shorted but for shorted stocks*

6.3.2. Empirical Analyses

Table A6 (of the Internet Appendix) shows the distributions of stock returns in week $w+1$ for each of CMO quintiles in week w. Extreme CMO quintiles are more dispersed than mild CMO quintiles: the centered 90% ranges of the weekly returns are 0.23%, 0.17%, 0.17%, 0.18%, and 0.22% from the first to the fifth quintile. The first CMO quintile ranges from -0.11% (5-percentile) to 0.12% (95-percentile), and the other quintiles also exhibit broad ranges. This wide dispersion of stock returns indicates the importance of skillful analysis at the individual stock level for investors, including short sellers and margin traders.

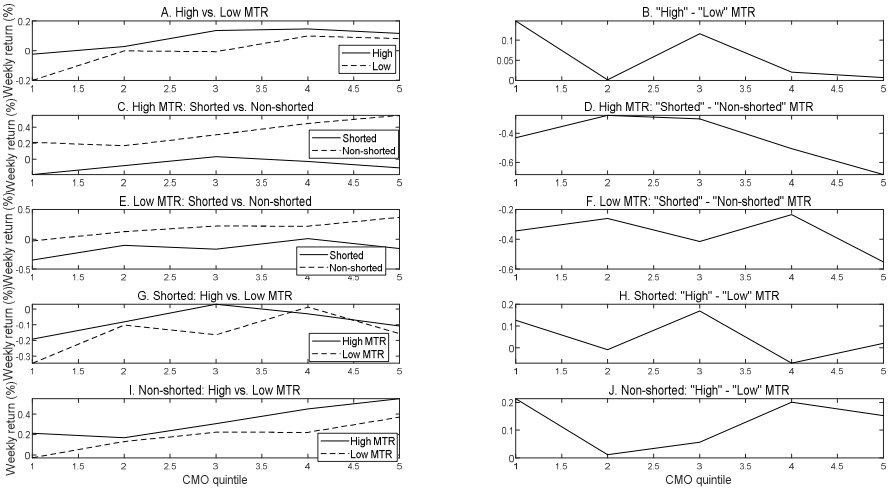
We define margin-traded stocks using the margin trading ratio (MTR), which is the ratio of the number of stocks purchased with the money borrowed from brokerage companies to the outstanding shares. Table A7 (of the Internet Appendix) shows the descriptive statistics for margin-traded stocks. The number of all margin-traded stocks (MTR > 0%) is 1,899 of 1,949 stocks on average. The average numbers of margin-traded stocks with an MTR greater than 1%, 2%, and 3% are 1,106, 753, and 505, respectively. Several firm characteristics (such as the average weekly return, average weekly return volatility, MOM, and the ROE) increase with the MTR, while others (such as firm size, firm age, and BM) decrease with the MTR. The price-to-earnings ratio does not exhibit a monotonic pattern along the level of MTR.

We define shorted stocks as stocks with a positive SIR and high-margin traded stocks as stocks with an MTR higher than 1%. This definition delivers a balanced sample size: the number of shorted stocks is 1,155, and the number of high-margin traded stocks is 1,106.

Portfolio Approach. Panels A and B of Figure 3 show that high-margin traded stock returns are higher than low-margin traded stock returns across CMO quintiles. However, the return difference between high- and low-margin traded stocks does not exhibit a

U-shaped pattern, and is insignificant, as shown in Panel G of Table A8 (of the Internet Appendix). This evidence does not support hypothesis (H2) that margin traders are informed investors who can efficiently analyze firm-specific sentiment.

Next, stocks are double-sorted into one of the four groups combining shorted/non-shorted and low/high-margin traded stocks to differentiate the effects of sentiment on shorted and margin-traded stocks. Panels C and D of Figure 3 show that for high-margin traded stocks, shorted stock returns are lower than non-shorted stock returns, particularly in the extreme sentiment quintiles. Panel H of Table A8 shows that risk-adjusted return differences are not only significantly negative but also inversely U-shaped across CMO quintiles. Similarly, Panels E and F of Figure 3 show that the shorted stock returns are lower than non-shorted stock returns, particularly in the highest sentiment quintile, and for low-margin traded stocks. Panel I of Table A8 shows that the risk-adjusted return differences are significantly negative and lowest in the highest sentiment quintile. A combination of these results supports hypothesis (H3) that short sellers are efficient in analyzing firm-specific sentiment irrespective of the existence of margin traders.



Notes: The figure shows the weekly average risk-adjusted returns of CMO-sorted equal-weight portfolios combining shorted/non-shorted stocks with high/low-margin traded stocks and their return differences. Shorted stocks refer to stocks with a positive short interest ratio (SIR). High (low) margin-traded stocks indicate stocks with a margin trading ratio (MTR) higher (lower) than 1%. We used the Fama-French-Carhart four-factor model for risk adjustment.

Figure 3. Weekly Risk-Adjusted Returns of CMO-Sorted Equal-Weight Portfolios Combining Shorted/Non-Shorted Stocks with High/Low-Margin Traded Stocks and Their Return Differences.

By contrast, Panels G and H of Figure 3 show that for shorted stocks, high-margin traded stock returns are not consistently higher than low-margin traded stock returns. In addition, Panel J of Table A8 shows that the risk-adjusted return differences are not significantly positive nor exhibit a U-shaped pattern. However, Panels I and J of Figure 3 show that high-margin traded stock returns are higher than low-margin traded stock returns for non-shorted stocks; the risk-adjusted return difference is significant in the lowest and fourth sentiment quintiles. These results imply that the sentiment effect on margin-traded stock returns varies substantially, depending on whether stocks are shorted or not, and do not support hypothesis (H4) that margin traders are efficient in analyzing investor sentiment irrespective of the existence of short sellers. In sum, short sellers are skilled at analyzing sentiment, whereas margin traders are not.

Panel regressions. We conduct panel regressions to confirm the portfolio-based results. The panel regression Model (2) is specified as follows:

Model (2):

$$r_{i,w+1} = \alpha_i + \beta_2 MTRdum_{i,w} + \beta_3 CMO_{i,w} + \beta_5 MTRdum_{i,w} \times CMO_{i,w} + \beta_7 CMO_{i,w}^2 + \beta_9 MTRdum_{i,w} \times CMO_{i,w}^2 + \gamma \ \mathrm{X}_{i,w} + \varepsilon_{i,w+1}, \quad (8)$$

where $MTRdum_{i,w}$ denotes a dummy variable which takes the value of one for high-margin traded stocks (with MTR>1%) and zero otherwise.

Table 5 shows the result for panel regression Model (2). Coefficient (β_5) of the interaction between $MTRdum$ and CMO is insignificantly positive. Coefficient (β_9) for the interaction between $MTRdum$ and $CMO^2$is insignificantly negative. This panel regression result does not support hypothesis (H2) that the return difference between high- and low-margin traded stocks shows a positive and U-shaped pattern along the CMO level.

The panel regression Model (3) combines Models (1) and (2) and is specified as follows:

Model (3):

$$\begin{aligned} r_{i,w+1} = \ & \alpha_i + \beta_1 SIRdum_{i,w} + \beta_2 MTRdum_{i,w} + \beta_3 CMO_{i,w} \\ & + \beta_4 SIRdum_{i,w} \times CMO_{i,w} + \beta_5 MTRdum_{i,w} \times CMO_{i,w} \\ & + \beta_6 SIRdum_{i,w} \times MTRdum_{i,w} \times CMO_{i,w} + \beta_7 CMO_{i,w}^2 \\ & + \beta_8 SIRdum_{i,w} \times CMO_{i,w}^2 + \beta_9 MTRdum_{i,w} \times CMO_{i,w}^2 \\ & + \beta_{10} SIRdum_{i,w} \times MTRdum_{i,w} \times CMO_{i,w}^2 + \gamma \ \mathrm{X}_{i,w} + \varepsilon_{i,w+1}. \end{aligned} \quad (9)$$

In this specification, sums of coefficients ($\beta_4 + \beta_6$) and ($\beta_8 + \beta_{10}$) capture the return difference between shorted and non-shorted stocks along CMO and CMO^2, respectively, for high-margin traded stocks. Both the coefficient sums are significantly

negative. Coefficients β_4 and β_8 capture the return difference between shorted and non-shorted stocks along CMO and CMO^2, respectively, for low-margin traded stocks. These two coefficients are also significantly negative. These results support hypothesis (H3) that shorted stock returns are lower than non-shorted stock returns for an extreme sentiment compared to mild sentiment, and this holds true not only for the non-margin trading but for margin-traded stocks.

Sums of coefficients ($\beta_5 + \beta_6$) and ($\beta_9 + \beta_{10}$) capture the return difference between high and low-margin traded stocks along CMO and CMO^2, respectively, for shorted stocks. Both the coefficient sums are positive, but insignificant. Coefficients β_5 and β_9 also capture the return difference between high- and low-margin traded stocks along CMO and CMO^2, respectively, for non-shorted stocks. These two coefficients are also insignificant. These results do not support hypothesis (H4) that margin-traded stock returns are higher than non-margin trading stock returns for an extreme sentiment compared to mild sentiment, and this holds true not only for the non-shorted but also for shorted stocks.

Our analysis of different investor groups-of short sellers and margin traders-builds on prior studies. Diether et al. (2002) investigate the hypothesis that prices will reflect an optimistic view when investors with the lowest valuations do not trade, and find supporting evidence that stocks with higher dispersion in analysts' earnings forecasts earn lower future returns. In our analysis, opinion differences can be measured using the SIR and MTR. Our result (Panel E of Table A8) shows that the high-margin traded and non-shorted stocks earn significantly positive returns, which is consistent with the hypothesis that prices will reflect an optimistic view when investors with the lowest valuations do not trade. In addition, we find negative returns for higher-dispersion stocks (i.e., shorted and margin-traded stocks in Panel C of Table A8), consistent with the findings of Diether et al. (2002). In sum, we use a different measure of opinion difference, but obtain similar results.

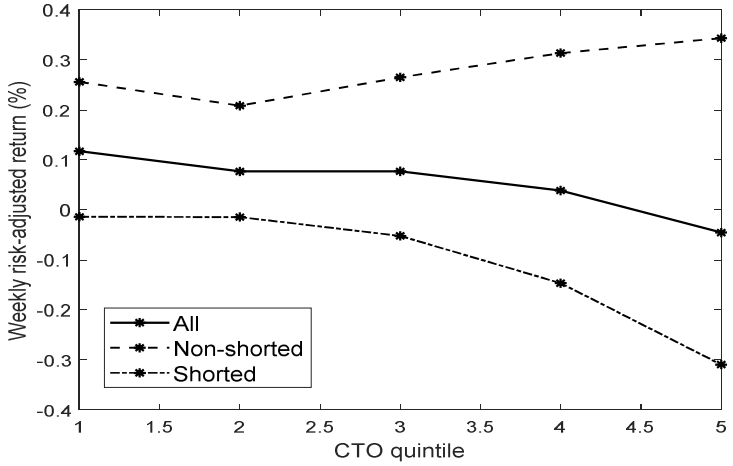
Nezafat et al. (2022) investigate the relationship between severe investor disagreement and stock returns based on the observed short-interest and long positions of hedge funds. They find that although active long or short positions on average predict subsequent stock returns, neither long investors nor short sellers can consistently predict them. However, we find negative returns for shorted and margin-traded stocks, particularly in the lowest sentiment quintile (Panel C of Table A8). This difference is attributable to the fact that the margin traders in our analysis are uninformed retail investors, whereas long positioners in Nezafat et al.'s (2022) analysis are informed hedge funds.

6.4. CTO

For robustness, we conduct our analyses based on the CTO instead of the CMO as a firm-specific investor sentiment index. We first investigate whether the CTO also satisfies characteristics that would be expected of a firm-level investor sentiment. Table

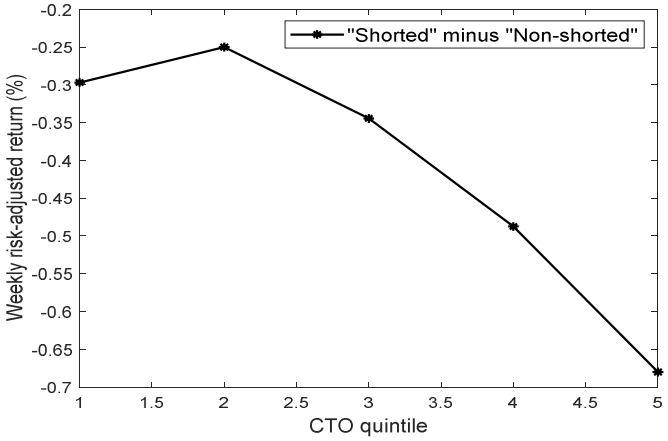
A9 (of the Internet Appendix) shows the short-term persistence of the CTO. The average CTOs in weeks $w+1$ to $w+4$ increase monotonically across the deciles, and the differences in return between CTOs in the highest and lowest deciles are positive and statistically significant. Table A10 (of the Internet Appendix) shows the results on the persistence of the CTO for each quartile of the five hard-to-value proxies. The difference between the highest and lowest CTO deciles for the average CTO in week $w+1$ increases with the firm-valuing difficulty for each of the hard-to-value measures; that is, short-term CTO persistence is stronger for firms that are more difficult to value. Table A11 (of the Internet Appendix) reports the results of the monthly time-series regression (6). Over twelve months following the period of high sentiment, after risk adjustments, stocks in the highest decile of the CTO significantly under-perform, compared to those in the lowest decile. In sum, these results suggest that the CTO is an appropriate measure of a firm-specific investor sentiment.

We then construct weekly equal-weight quintile portfolios based on the CTO in week w. Figure 4 shows the average risk-adjusted returns of the CTO-sorted quintile portfolios for week $w+1$ using all, non-shorted, and shorted stocks. Figure 5 shows the average risk-adjusted return difference for week $w+1$ between the equal-weight portfolios of shorted and non-shorted stocks for each CTO quintile. The risk-adjusted return differences between shorted and non-shorted stocks are negative and support hypothesis (H1) that shorted stock returns are lower than non-shorted stock returns, particularly for an extreme sentiment rather than a mild sentiment. This result confirms



Notes: This figure shows the weekly average risk-adjusted returns of the CTO-sorted quintile portfolios using all, non-shorted and shorted stocks. Shorted stocks refer to stocks with a positive short interest ratio (SIR). We used the Fama-French-Carhart four-factor model for risk adjustment.

Figure 4. Weekly Risk-Adjusted Returns of CTO-Sorted Equal-Weight Portfolios.



Notes: This figure shows the weekly average risk-adjusted return difference between the CTO-sorted equal-weight portfolios of shorted and non-shorted stocks. Shorted stocks refer to stocks with a positive short interest ratio (SIR). We used the Fama-French-Carhart four-factor model for risk adjustment.

Figure 5. Weekly Risk-Adjusted Return Difference between CTO-Sorted Equal-Weight Portfolios of Shorted Stocks and Those of Non-Shorted Stocks.

that hypothesis (H1) robustly holds for the CTO. However, the risk-adjusted return difference between shorted and non-shorted stocks shows an inverse U-shaped pattern for the CTO less clearly, compared to the CMO case. Moreover, the risk-adjusted return on all stocks is positive but tends to decrease with the CTO level, which is inconsistent with a positive relation between investor sentiment and future stock returns. These results imply that the CMO is a better firm-specific investor sentiment than the CTO.

6.5. Investor sentiment and earnings surprise

The lower returns of shorted stocks may come from potential sources other than sentiment-analyzing ability. Short sellers' informativeness has been studied from different angles, including their ability to anticipate negative earnings shocks (Daske et al., 2006), predict earnings restatements (Desai et al., 2006), and forecast downward analyst revisions (Francis et al., 2005). If our sentiment measure is unrelated with future earnings, then our results on short sellers' sentiment-analyzing ability are not driven by their ability to predict future earnings. To examine this issue, we compute earnings surprise as the difference between the current quarter's earnings and the average of analysts' earnings forecasts divided by the standard deviation of analysts' earnings forecasts. We then calculate correlation coefficients between earnings surprise at earnings announcement date and the corresponding previous CMO levels. The correlation coefficients are close to zero, ranging from -0.0009 to -0.0025 for lags of

zero to ten business days. This fact implies that the CMO measure is unrelated with future earnings and our results are not affected by short sellers' ability to predict future earnings.

7. CONCLUSION

This study examines the role of firm-specific sentiment on the returns of shorted stocks in the Korean stock market. We find evidence that short sellers are skilled at analyzing firm-specific sentiment. The effect of sentiment on shorted stock returns is pronounced for stocks with a high return volatility, low profitability, high price-to-earnings ratio, high momentum, and a low book-to-market ratio. By contrast, margin traders are not skilled at analyzing firm-specific sentiment. Short sellers possess superior skills compared to margin traders. This result may be subject to specific characteristics pertaining to the Korean stock market: short sellers are mostly institutional investors, while margin traders are retail investors in the Korean stock market. Thus, it would be worthwhile to explore the firm-specific sentiment effect on shorted stock returns in other markets with different characteristics.

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Received Septamber 20, 2023, Accepted December 22, 2023.