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VIRAL TRENDS AND STOCK MARKETS: SPILLOVERS BETWEEN MEME ASSETS AND SECTORAL RETURNS

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Abstract

Meme assets are a unique and modern phenomenon in the stock market, characterized by social media-driven hype and significant price volatility. The aim of this paper is to explore the relationships between meme assets and sectoral dynamics. We employ the Granger causality test to examine predictive relationships between daily returns of GameStop and five meme exchange traded funds and eleven sector index funds. Our results show that selected meme assets have relatively limited impact on various sectoral indices and vice versa, suggesting that meme stocks and meme ETFs can offer diversification benefits for sectoral investments. These findings offer insights to investors in designing their approaches to investment strategies and portfolio management, as well as regulators in their attempt to ensure financial market stability.

JEL classification: G41, G15, C32

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Introduction

In the last three years, meme stocks have attracted considerable interest from investors, regulators and researchers. A meme stock is a type of stock that gains rapid popularity and experiences dramatic price increases primarily due to hype on social media and online forums, rather than the company's financial performance or fundamentals. These stocks are typically driven by retail investors who rally around them on platforms like Reddit and X, creating a viral effect that leads to significant price swings. Yang (2023) finds that meme investors are significantly less wealthy than traditional investors, trade via digital trading platforms, rely on social media information for investment decision making, and use meme stock investing to express their frustration with traditional financial institutions, which was also indicated by Chohan (2023). The investor attention and huge volatility of meme stocks have raised concerns about potential market manipulation and effects on the broader financial system. Having in mind the interconnectedness of modern financial markets and the potential for localized phenomena to have widespread consequences, we examine the impact of meme assets on sectoral dynamics, using the S&P500's sector index funds as proxies.

The meme stock phenomenon began in early 2021 with the dramatic rise of GameStop's stock price. This surge was largely driven by a community of retail investors on the subreddit r/WallStreetBets. Initially, GameStop, a struggling video game retailer, was heavily shorted by institutional investors who bet that the stock price would fall. However, members of r/WallStreetBets recognized this high short interest and coordinated a massive buying effort. This collective action led to a short squeeze, forcing short sellers to buy shares to cover their positions, which further drove up the stock price. The success of this strategy inspired similar actions with other heavily shorted stocks, such as AMC Entertainment.

A new dynamic in stock trading, driven by online communities and viral trends on social media platforms, has raised concerns about potential market manipulation and the stability of the broader financial system. Regulatory bodies worry that coordinated trading induced by social media posts can lead to manipulated changes of stock prices, which may distort market mechanisms and undermine market confidence. Additionally, the sudden influx of retail investors and the ensuing market frenzy can strain brokerage systems, exacerbating market instability.

The influence of meme stocks extends beyond the companies directly involved. For instance, the heightened volatility and trading volumes associated with meme stocks can affect the stock prices of other companies within the same industry, as documented by Allen et al. (2021). This phenomenon can potentially create ripple effects across entire sectors, and in extreme cases, the instability induced by meme stock trading could contribute to broader market corrections if left unchecked. Although literature dealing with stock market integration and spillovers across aggregate equity markets has been rather extensive, the literature on sectoral spillovers is relatively scarce. However, several studies have shown that sectoral markets perform differently against local and global shocks compared to aggregate equity markets (Kraus, 2001; Brooks et al., 2004) and offer significantly greater diversification benefits compared to the gains from diversification across countries (Moerman, 2008; Balli & Balli, 2011). Therefore, understanding how meme stocks affect sectoral dynamics can be of a great importance to both investors and regulators.

We use the Granger causality test to examine predictive relationships between meme assets and eleven sectoral indices. Our data sample contains daily data of the most iconic meme stock (GameStop – GME) and five meme exchange traded funds (The Roundhill Meme ETF – MEME; The iShares MSCI USA Momentum Factor ETF – MTUM; The SOFI Social 50 ETF – SFYF; VanEck Vectors Social Sentiment ETF – BUZZ; and ARK Innovation ETF – ARKK) from their respective inception day until 22 June 2023, as well as daily data for exchange traded funds that divide S&P500 index into eleven sector index funds: XLP (Consumer Staples), XLY (Consumer Discretionary), XLF (Financials), XLV (Health care), XLI (Industrials), XLB (Basic Materials), XLE (Energy), XLK (Technology), XLU (Utilities), XLC (Communications), XLRE (Reals Estate). Our results show that selected meme assets have relatively limited impact on various sectoral indices and vice versa, suggesting that meme stocks and meme ETFs can offer diversification benefits for sectoral investments.

Our paper contributes to the literature in several ways. First, to our knowledge this is one of the first studies that examines how meme assets affect sectoral dynamics. Previous studies have predominantly explored how social media sentiment, in particular sentiment on platforms like Reddit, and specifically the r/WallStreetBets subreddit, can predict and influence stock price movements. Only a small number of studies focus on the spillovers between meme stocks and other financial assets, for example cryptocurrencies, stocks and other traditional assets (Li, 2022; Aloosh et al., 2022; Yousaf et al., 2023; Jung & Jeong, 2021; Bank & Abdioğlu, 2023). While these studies provide important evidence into the predictive power of social media sentiment on meme stock performance, herding behavior, market manipulation, and broader market implications, the influence of meme assets on sectoral dynamics has not been widely explored. To the best of

our knowledge, only Elsayed et al. (2024) studied the connectedness between meme coins, stocks, and sectoral markets, finding that meme stocks and coins are relatively disconnected from the sectoral markets, with the short-term spillovers dominating both medium- and long-term spillovers. Our paper aims to add to this stream of very scarce literature. Further, in addition to the most investigated meme stock, GameStop – GME, our study is the first to explore the effect of meme exchange traded funds on sectoral indices. As the number of thematic ETFs has increased in recent years, boosted by their attractiveness to investors wanting to tap into a specific theme or trend, we believe that understanding how they shape sectoral dynamics can provide valuable insights to investors and regulators.

The rest of the paper is organized as follows. Section 2 presents the review of relevant literature. Section 3 presents the methodology. Section 4 describes the data and preliminary analysis. Section 5 presents the results of empirical analysis, and Section 6 concludes.

Literature review

A growing body of literature has been devoted to analyzing meme stocks phenomenon in recent years, particularly following the GameStop rally in early 2021. Several streams of literature are presented in this section. The dominant strand of literature focuses on exploring how sentiment on social media platforms like Reddit, and specifically the r/WallStreetBets subreddit, can predict and influence meme stock price movements. Cruz et al. (2023) demonstrated the effectiveness of machine learning in forecasting meme stock prices using a mix of fundamental, technical and social media sentiment indicators. Long et al. (2023) as well as Li (2022) found that sentiments on r/WallStreetBets have large impacts on asset prices and significantly affected GameStop's intraday returns. Kim et al. (2023) find that the sentiment and volume of social media posts influenced GameStop's trading volume and led to irrational trading behavior. The tone of discussions as a predictor of GameStop's returns was also underscored by Anand and Pathak (2022), who detected significant and positive association with future GameStop's return, volatility, bid–ask spreads and volumes. Vasileiou et al. (2023) as well as Vasileiou and Tzanakis (2022) provide evidence that the sentiment variables such as Google searches, put-call ratio, and trading volume can help explain the stock's performance. Reschke and Strych (2024) demonstrate that emojis predict future short-term stock returns that surpass the effect of plain text sentiment, especially for volatile stocks. Suchanek (2024) used a vector autoregression model framework and found that higher sentiment in social media postings leads to increased trading volume and returns across multiple stocks. Costola et al. (2021) find that meme stocks share common dynamics for price, volume, and social activity, and were able to identify momentum which is significant and positively related to the stock's returns. Herding behavior of retail investors on social media platforms driving market fluctuations has been identified by Semenova et al. (2024), Takagi (2022) who detected negative bubbles in meme stocks, and Zhao et al. (2023) also supporting the idea that social media sentiment could forecast changes in collective behavior of market participants, with moderately negative sentiment being associated with a higher probability of a stock becoming a meme stock. These findings challenge the traditional view of retail investors as noise traders and suggest that they can have a disruptive effect on financial markets.

Another stream of literature focuses on the market efficiency implications of meme stock trading. Aloosh et al. (2023) find that meme stock trading does not have a negative impact on market efficiency. Having analyzed hourly data, they provide empirical evidence that a trading ban on meme stocks led to increased illiquidity and volatility in both the meme stock market and the broader S&P500 index, raising concerns about unintended consequences of the ban. This finding is in contrast to earlier research conducted by Vasileiou (2022) who found that GameStop (GME) stock returns were not randomly distributed during the examined period, indicating a violation of the Efficient Market Hypothesis (EMH).

Several studies analyzed the profitability of trading strategies based on WallStreetBets recommendations with mixed conclusions. Although Buz and de Melo (2024) find that an investment portfolio based on WallStreetBets recommendations significantly outperformed the S&P 500 in the observed period, other studies demonstrated that that such strategies were not profitable on a risk-adjusted basis (Chacon et al., 2023; Reichenbach & Walther, 2023). Further, Bradley et al. (2024) reveal that recommendations on the WSB platform became less reliable in predicting returns after the GameStop event, thereby negatively impacting smaller investors. Liang (2022) finds that delta-neutral hedging strategies applied to meme stocks do not significantly mitigate investor losses in the short term but can still offer some risk reduction compared to having no hedge at all.

The motivations behind meme stock trading have also been scrutinized. Research on meme stock trading motivations reveals a shift from primarily financial to increasingly emotional drivers over time (Bhakar & Pearce, 2022). Several studies suggest that investors in meme assets are driven by gambling tendencies (Hasso et al., 2022; Philander, 2023). These insights

support Han and Kumar's (2013) findings that stocks with high retail trading have strong lottery features that attract retail investors with a gambling propensity.

Finally, the interconnectedness between meme stocks and other financial assets has also been explored by the researchers Li (2022) examined the spillover effects between Bitcoin and meme stocks, discovering a unidirectional wealth transfer from meme stocks to Bitcoin, as well as volatility spillovers in both directions. Aloosh et al. (2022) found multiple periods of price explosiveness in meme stocks and co-explosivity between meme stocks and cryptocurrencies, suggesting that social media and new trading apps are influencing interactions between equity and cryptocurrency markets in potentially destabilizing ways. Yousaf et al. (2023) provided evidence that meme stocks and meme tokens exhibit time-varying connectedness with traditional financial assets (such as stocks, gold, oil, U.S. dollars, and U.S. Treasuries), with the highest connectedness at the extreme upper and lower quantiles. During price bubbles or short squeezes, meme assets can transmit shocks to other markets, causing contagion, while they are more likely to receive shocks during extreme negative market conditions. Jung and Jeong (2021) discovered that societal mood variables are important in explaining index prices, with large-cap U.S. stock indices showing a stronger relationship to sentiment intensity and user engagement variables extracted from internet memes, than small-cap international indices. Bank and Abdioğlu (2023) provided evidence that there was an asymmetric volatility spillover from the GME index (representing GameStop stock) to the NYSE Composite index, with negative shocks having a greater impact than positive shocks. On the other hand, there was no such spillover in the opposite direction.

To the best of our knowledge, the study by Elsayed et al. (2024) is the only one examining the connectedness between sectoral markets and meme stocks and coins. The results of the study show that the short-term spillovers dominate both medium- and long-term spillovers. Furthermore, meme stocks and coins are net receivers of shock, along with the energy, communication services, utilities, and real estate sectors, whereas other sectors are net transmitters. The study shows that meme stocks and meme coins are disconnected from and minimally affected by the fluctuations in the sectoral markets.

Methodology

To investigate the relationship between the meme assets (two meme stocks and five meme exchange traded funds) and broad market index and sectoral indices, we estimate a vector autoregressive (VAR) model, where Y_t is a vector that contains the variables of interest and a VAR(k) model is:

$$Y_t = c + \sum_{j=1}^{k} A_j Y_{t-j} + \varepsilon_t \quad (1)$$

where Y_t is a vector that contains n variables, c is a constant, A_j is coefficient matrix, and et is a vector of the error correction terms in the model. The lag length is selected using the lag length determined by the Bayesian Information Criterion and Likelihood Ratio (LR) Test.

From these VAR models, we employ the linear Granger causality test (Granger, 1969) to check if meme assets can help predict sectoral stock dynamics. The Granger bivariate causality test is a useful tool for understanding the predictive relationships between time series. Granger causality does not imply true causality but rather predictive causality. If a time series X Granger-causes another time series Y, it means that past values of X contain information that helps predict Y beyond what is contained in past values of Y alone. Therefore, it provides valuable insights into which variables may help forecast others, guiding further analysis and decision-making.

The Granger causality bivariate models are as follows:

$$Y_{i,t} = \beta_0 + \sum_{j=1}^{k} \beta_j Y_{i,t-j} + \sum_{j=1}^{k} \gamma X_{i,t-j} + \varepsilon_{it} \quad (2)$$

$$X_{i,t} = \beta_0 + \sum_{j=1}^{k} \beta_j X_{i,t-j} + \sum_{j=1}^{k} \gamma X_{i,t-j} + \varepsilon_{it} \quad (3)$$

where $Y_{i,t}$ is the return of meme asset i at time t, while $X_{i,t}$ refers to the return of the US sector index i at time t. k are the lag lengths. β_j and γ_j are the coefficient matrixes and $\varepsilon_{i,t}$ is the prediction error. For all our time series we run an Augmented Dickey-Fuller test to check for stationarity.

Data

This study employs daily data of the meme stock, GameStop-GME, and five meme exchange traded funds (The Roundhill Meme ETF – MEME; The iShares MSCI USA Momentum Factor ETF – MTUM; The SOFI Social 50 ETF – SFYF; VanEck Vectors Social Sentiment ETF – BUZZ; and ARK Innovation ETF – ARKK) from their respective inception day until 22 June 2023. The overview of selected meme assets is presented in Appendix 1. Furthermore, to approximate for US sectoral dynamics, we obtain daily data for exchange traded funds that divide the S&P500 into eleven sector index funds: XLP (Consumer Staples), XLY (Consumer Discretionary), XLF (Financials), XLV (Health care), XLI (Industrials), XLB (Basic Materials), XLE (Energy), XLK (Technology), XLU (Utilities), XLC (Communications), XLRE (Reals Estate). The longest sample time period is from 16 April 2014 to 22 June 2023, to match the sector index fund data with the thematic meme ETF withwith the longest time range. All data are obtained from Yahoo Finance.com. We log-difference the variables for our empirical analysis.

Table 1: Descriptive statistics

	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	JB
GME	-0.0015	-0.0027	0.3019	-0.1971	0.0588	0.8101	6.8033	274.16
ARKK	-0.0023	-0.0038	0.1356	-0.1065	0.0379	0.1937	3.0704	2.49
BUZZ	-0.0012	-0.0022	0.0830	-0.0727	0.0250	0.0842	2.9177	0.56
MEME	-0.0022	-0.0034	0.1070	-0.1152	0.0348	0.0108	3.0026	0.01
MTUM	-0.0006	-0.0004	0.0393	-0.0491	0.0139	-0.2327	3.8134	14.09
XLB	-0.0001	-0.0001	0.0539	-0.0398	0.0145	0.1208	3.4206	3.77
XLC	-0.0004	-0.0002	0.0636	-0.0692	0.0177	-0.0425	4.0606	18.16
XLE	0.0010	0.0014	0.0550	-0.0864	0.0204	-0.4135	3.8630	22.92
XLF	-0.0004	-0.0009	0.0493	-0.0415	0.0143	0.0123	3.5391	4.67
XLI	0.0000	0.0005	0.0411	-0.0384	0.0127	-0.0478	3.2959	1.55
XLK	0.0000	-0.0009	0.0790	-0.0545	0.0185	0.0966	3.5430	5.33
XLP	0.0002	0.0007	0.0317	-0.0665	0.0100	-0.8203	8.1220	464.03
XLRE	-0.0007	-0.0011	0.0739	-0.0494	0.0151	0.0838	4.5730	40.14
XLU	0.0000	0.0003	0.0461	-0.0471	0.0125	-0.1698	3.9604	16.65
XLV	0.0000	0.0002	0.0302	-0.0372	0.0107	-0.1512	3.2870	2.79
XLY	-0.0005	-0.0008	0.0705	-0.0676	0.0193	-0.1931	3.5292	6.88

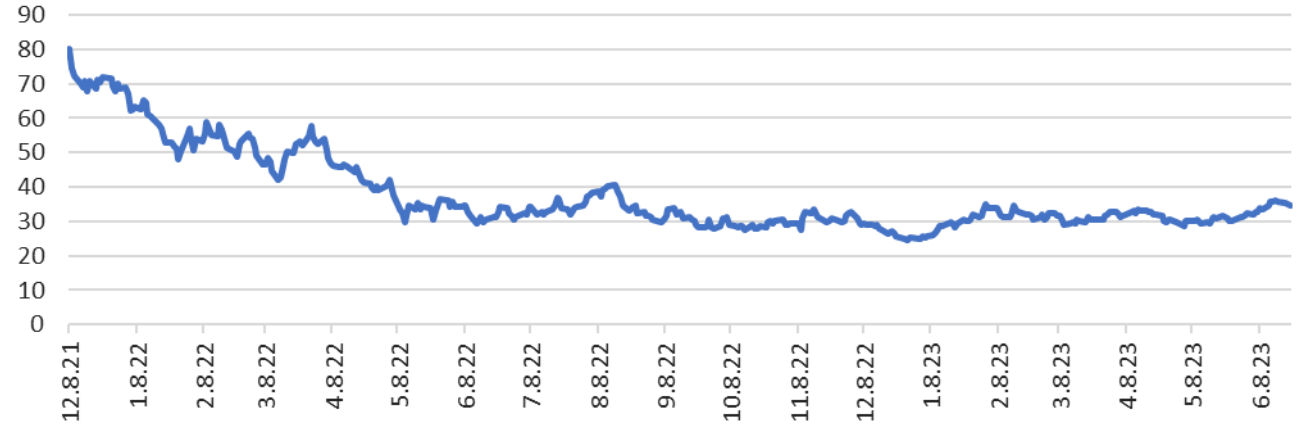
Source: Author's own work.

Table 1 presents the descriptive statistics and the tests for normality of daily returns covering the period from 09/12/2021 and 22/06/2023, corresponding to the joint period for which the data for all series are available. In this period most daily returns have a negative mean. Standard deviations of returns for the observed meme assets are generally higher than for sectoral indices. GameStop stock returns exhibit the highest standard deviation (0.059), while the lowest standard deviation is exhibited by the sector of consumer staples XLP (0.0099). In addition to negative means, returns of all meme assets except for MTUM were positively skewed in the observed period, illustrating unique risk-return characteristics of GameStop stock and the majority of thematic meme exchange traded funds. As mentioned before, they are characterized by high volatility based on social media trends, news, or coordinated buying and selling by retail investors, often driven by speculation rather than fundamental analysis, leading to erratic price movements. Occasional massive price spikes due to sudden bursts of buying interest, viral trends, or short squeezes contribute to positive skewness, however over time, as the hype fades or fundamental valuation concerns arise, prices often correct downwards, resulting in a negative mean return. The ADF test indicates that the series are stationary.

Figure 1: Prices of meme ETFs and GameStop (SFYF)

Source: Author's own work.

Figure 2: Prices of meme ETFs and GameStop (MEME)

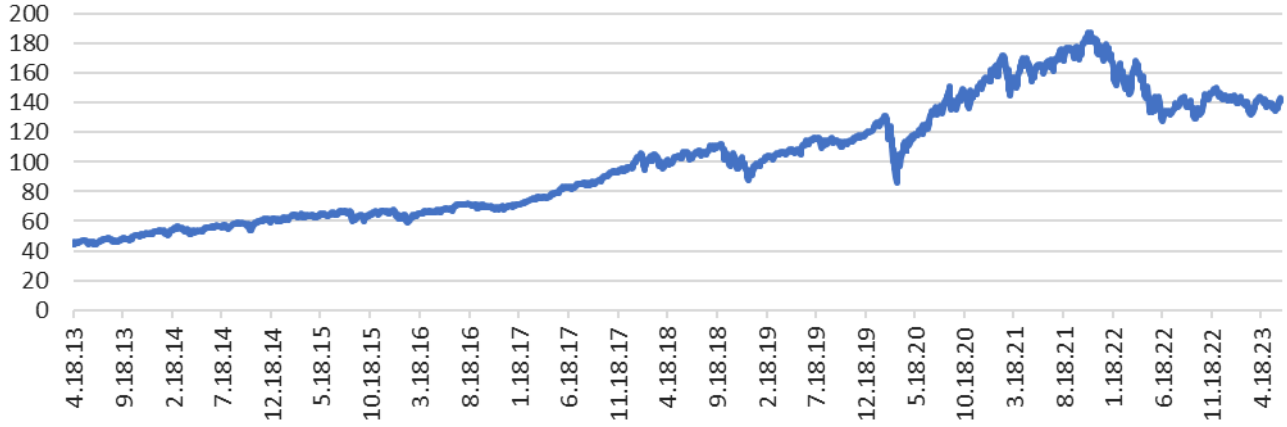


Source: Author's own work.

Figure 3: Prices of meme ETFs and GameStop (BUZZ)

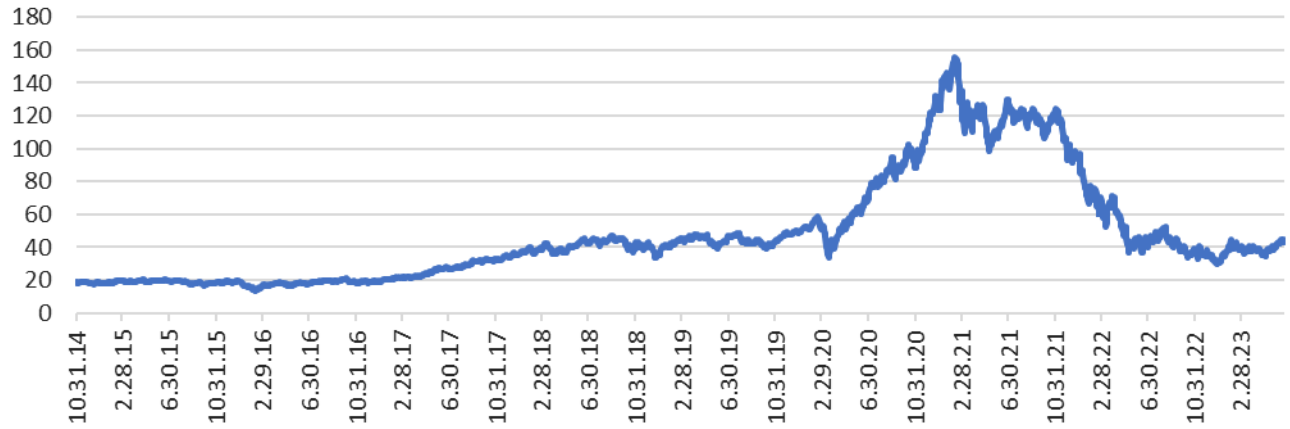
Source: Author's own work.

Figure 4: Prices of meme ETFs and GameStop (MTUM)



Source: Author's own work.

Figure 5: Prices of meme ETFs and GameStop (ARKK)

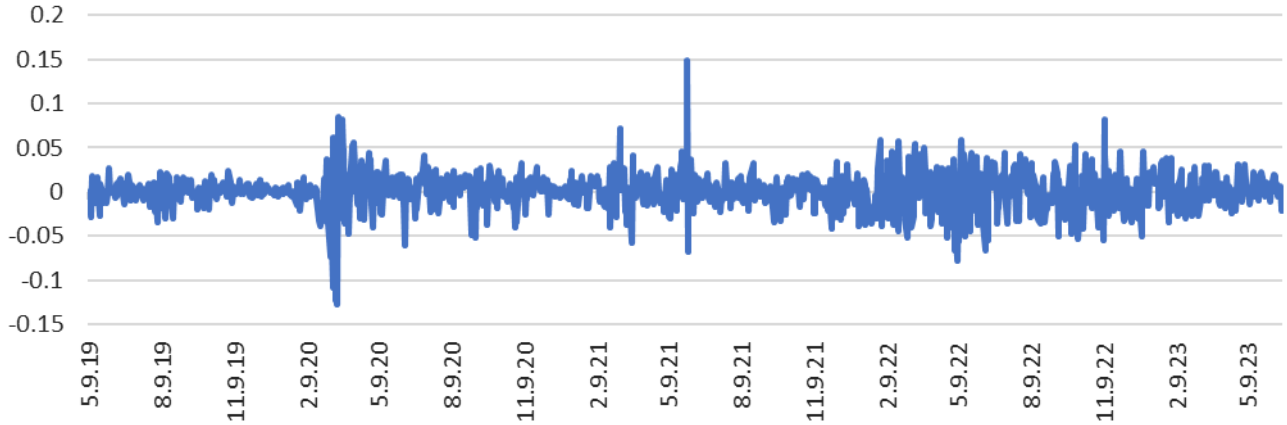


Source: Author's own work.

Figure 6: Prices of meme ETFs and GameStop (GME)

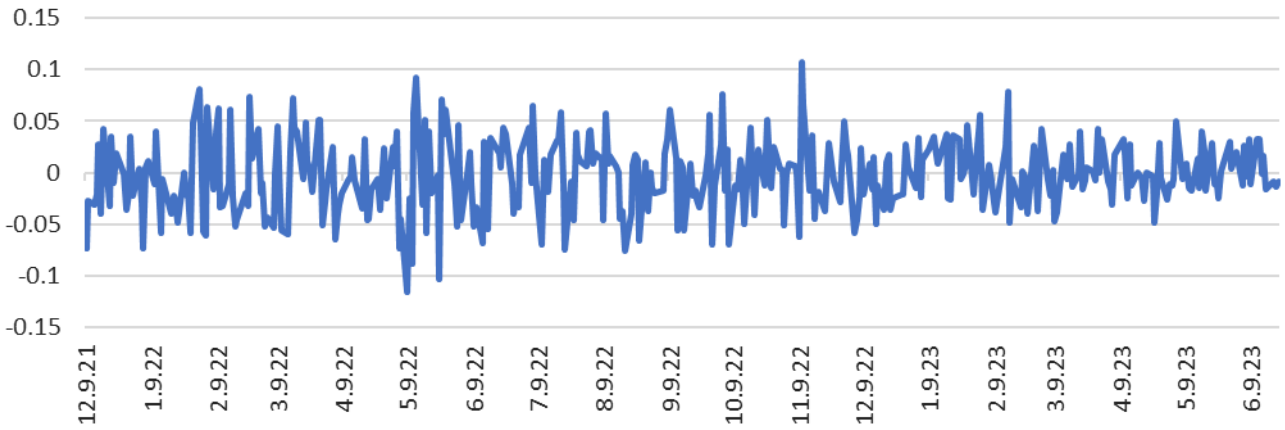
Source: Author's own work.

Figure 7: Returns of meme ETFs and GameStop (SFYF)



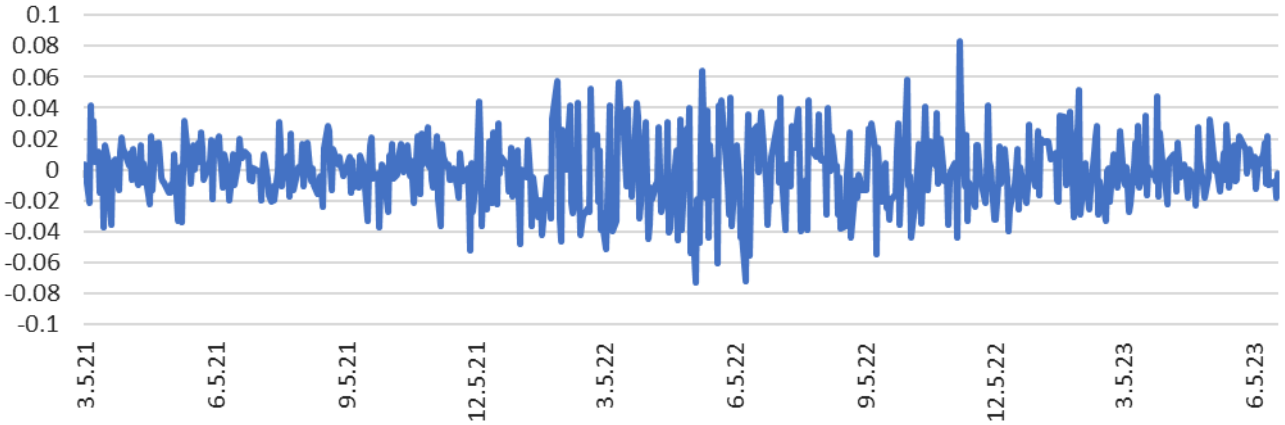
Source: Author's own work.

Figure 8: Returns of meme ETFs and GameStop (MEME)



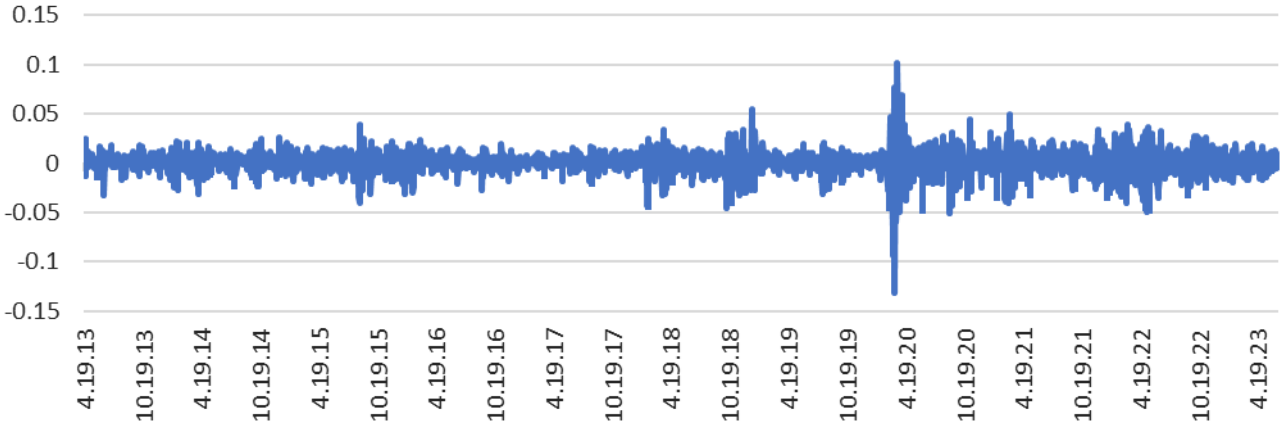
Source: Author's own work.

Figure 9: Returns of meme ETFs and GameStop (BUZZ)



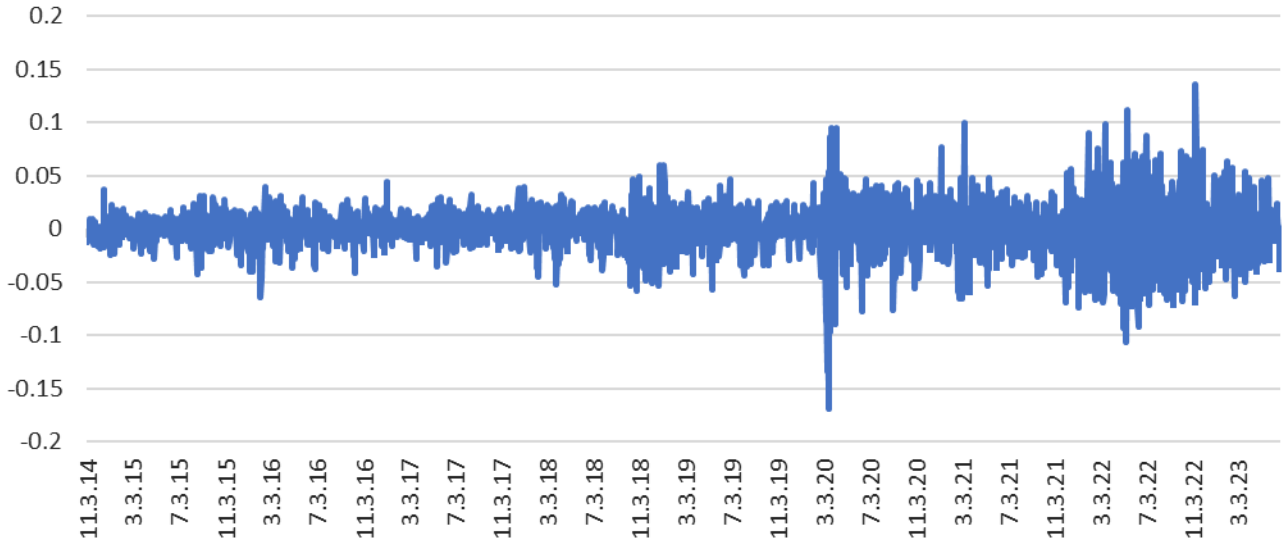
Source: Author's own work.

Figure 10: Returns of meme ETFs and GameStop (MTUM)



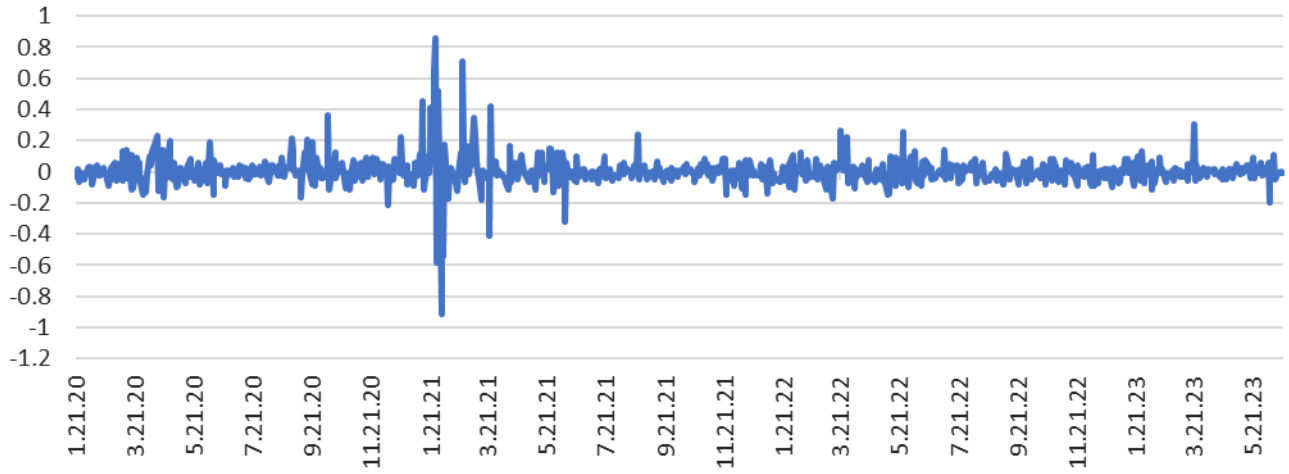
Source: Author's own work.

Figure 11: Returns of meme ETFs and GameStop (ARKK)



Source: Author's own work.

Figure 12: Returns of meme ETFs and GameStop (GME)



Source: Author's own work.

Figure 1-6 presents daily adjusted closing prices while Figure 7-12 shows returns of the observed meme assets. All of them, especially MEME, SYFY, and ARKK, exhibited significant volatility, with sharp peaks and troughs. ARKK and MTUM exhibited a strong growth during 2020 and reach their peak values around early and late 2021, respectively. After the peak, they experience a decline, with varying degrees of recovery and stabilization. MEME ETF was launched in December 2021 with an aim to capitalize on the meme stocks frenzy that started earlier that year with GameStop stock. However, over the observed period MEME's prices exhibited a downward trend and it never recovered to its starting value level. By June 2023, most ETFs have stabilized at lower levels compared to their peaks, indicating a period of market correction or adjustment.

Results

In this section we present the results of the Granger bivariate causality test which was employed to investigate short term relationships between US sectoral indices and thematic meme exchange traded funds.

The results are presented in Tables 2-4. Table 2 provides the summary of directions of the Granger causality tests, while detailed results are presented in Tables 3 and 4.

Table 2: Direction of the Granger causality found between meme ETFs and US sectoral indexes

	XLB	XLC	XLE	XLF	XLI	XLK	XLP	XLRE	XLU	XLV	XLY
GME											<-
MEME			<-			->			<-		
SFYF	<-						<->				
BUZZ											
MTUM				<-	<-						
ARKK		->				<->	->				

Source: Author's own work.

Table 3 presents the results of the Granger causality test between returns of various meme assets (GME, MTUM, SFYF, MEME, BUZZ, ARKK) on the one side, and the returns of eleven sector ETFs representing sectoral indices on the other (XLB, XLE, XLF, XLI, XLK, XLP, XLU, XLV, XLY, XLC, XLRE). The null hypothesis (H_0) for each test is that the respective meme asset does not Granger-cause the sectoral index. The results are summarized based on the Chi-square statistics and p-values (in parentheses).

These results suggest that meme assets have relatively limited impact on various sectoral indexes. In particular, the results of our analysis show that MEME ETF does Granger cause XLK, indicating that past values of MEME returns contain information that helps predict returns in the technology sector with strong statistical significance. Further, ARKK does Granger cause XLC, XLK and XLP, suggesting that past values of ARKK returns can help predict with strong statistical significance returns in the communications, technology and consumer staples sectors. SFYF does Granger cause XLP, indicating that past returns of SFYF can help predict dynamics in consumer staples. GME, BUZZ and MTUM do not Granger cause any of the sectoral indexes. Overall, the sectors whose dynamics are influenced by thematic meme exchange traded funds are technology, consumer staples, and communications.

Table 3: Results of the Granger causality test between meme assets and US sectoral indices returns

	XLB	XLC	XLE	XLF	XLI	XLK
GME	16.5457 [0.6822]	7.5529 [0.9944]	22.4317 [0.3176]	18.3543 [0.5641]	18.2496 [0.5710]	8.8455 [0.9846]
MEME	0.4084 [0.9385]	4.9752 [0.1736]	0.3721 [0.9459]	0.6245 [0.8908]	0.8284 [0.6088]	6.4047 [0.0935]*
SFYF	17.9561 [0.8442]	19.4143 [0.7768]	13.1254 [0.9749]	18.0134 [0.8418]	15.8360 [0.9196]	23.0735 [0.5733]
BUZZ	22.0128 [0.6880]	14.6593 [0.9633]	28.4153 [0.3383]	29.7934 [0.2763]	23.2905 [0.6165]	17.0874 [0.9064]
MTUM	8.4488 [0.8647]	10.9730 [0.6882]	11.6479 [0.6346]	7.5481 [0.9115]	10.1002 [0.7548]	14.2603 [0.4305]
ARKK	24.1018 [0.2380]	32.4103 [0.0391]**	28.8713 [0.2481]	20.1099 [0.4511]	23.5086 [0.2645]	32.3829 [0.0394]**
GME	15.7021 [0.7349]	19.5570 [0.4859]	15.0465 [0.7737]	17.4870 [0.6212]	11.5870 [0.9296]	
MEME	5.5103 [0.1611]	0.7063 [0.6355]	3.1471 [0.3695]	2.0870 [0.5545]	3.6485 [0.3020]	
SFYF	34.3784 [0.0999]*	18.2599 [0.8312]	32.1752 [0.1530]	23.9709 [0.5211]	24.9869 [0.4631]	
BUZZ	21.0959 [0.7370]	16.9431 [0.9108]	26.0108 [0.4625]	14.2867 [0.9690]	20.7143 [0.7566]	
MTUM	13.6465 [0.4764]	9.2838 [0.8125]	11.0979 [0.6783]	12.6108 [0.5574]	13.1431 [0.5153]	
ARKK	31.6574 [0.0471]**	28.2458 [0.1037]	22.9356 [0.2920]	25.0412 [0.1999]	26.9062 [0.1379]	

Null hypothesis (H_0): Respective meme asset does not Granger-cause the sectoral index. The presented results are Chi-square statistics and p-values (in parentheses). ***, ** and * indicate that Ho was rejected at 1%, 5% and 10% levels, respectively.

Source: Author's own work.

Table 4: Results of the Granger causality test between US sectoral indices and meme assets returns

	XLB	XLC	XLE	XLF	XLI	XLK
GME	10.5137 [0.9579]	9.4832 [0.9766]	13.2324 [0.8672]	16.6931 [0.6767]	10.2152 [0.9641]	12.7527 [0.8877]
MEME	4.5211 [0.2104]	1.5157 [0.6786]	8.9664 [0.0297]**	4.6563 [0.1988]	1.9970 [0.5730]	1.2629 [0.7380]
SFYF	38.5340 [0.0410]**	15.0064 [0.9412]	19.7130 [0.7617]	27.8779 [0.3135]	17.7137 [0.8543]	22.6820 [0.5961]
BUZZ	21.7361 [0.7030]	27.0258 [0.4080]	32.1085 [0.1896]	27.5638 [0.3803]	20.6982 [0.7574]	28.4311 [0.3376]
MTUM	19.5655 [0.1444]	14.2739 [0.4295]	18.4522 [0.1870]	25.8905 [0.0267]**	24.2401 [0.0429]**	16.4285 [0.2879]
ARKK	27.4129 [0.1240]	19.1694 [0.5108]	15.4218 [0.7518]	21.1903 [0.3860]	15.0802 [0.7718]	32.3793 [0.0394]**
	XLP	**XLRE**	**XLU**	**XLV**	**XLY**	
GME	19.4567 [0.4923]	16.1122 [0.7096]	16.9860 [0.6539]	22.5205 [0.3129]	3.6330 [0.0474]**	
MEME	1.8646 [0.6010]	6.1566 [0.1042]	6.6538 [0.0838]*	0.2618 [0.9671]	0.7583 [0.8596]	
SFYF	46.4900 [0.0056]***	22.3753 [0.6140]	19.4718 [0.7740]	19.1401 [0.7904]	32.2084 [0.1521]	
BUZZ	23.9760 [0.5773]	23.8831 [0.5826]	24.2104 [0.5639]	26.9121 [0.4140]	24.8996 [0.5247]	
MTUM	18.5975 [0.1809]	18.6478 [0.1788]	13.2077 [0.5102]	14.2629 [0.4303]	20.9257 [0.1036]	
ARKK	27.7244 [0.1161]	13.2990 [0.8642]	19.6724 [0.4786]	14.6512 [0.7960]	22.2773 [0.3257]	

Null hypothesis (H_0): Respective meme asset does not Granger-cause the sectoral index. The presented results are Chi-square statistics and p-values (in parentheses). ***, ** and * indicate that Ho was rejected at 1%, 5% and 10% levels, respectively.

Source: Author's own work.

We also carried out the Granger causality test in the other direction to examine whether the returns of sector ETFs influence the returns of various meme assets. The null hypothesis (H_0) for each test is that the respective sectoral index does not Granger-cause the thematic meme ETF. The results are presented in Table 4. The results show that GME is influenced by the dynamics in the consumer discretionary sector. ARKK is influenced by the technology sector. MEME is influenced by the dynamics in energy and utilities, MTUM by financials and industrials, while BUZZ does not seem to be sensitive to influences from any sector. As can be seen, sectors are more information transmitters than recipients.

The analysis indicates that GameStop and selected meme exchange traded funds (ETFs) have a relatively limited impact on sectoral markets and vice versa. This conclusion is supported by Elsayed et al. (2024), who demonstrated that in the short run, meme stocks and coins are primarily net receivers of shocks and are less integrated with sectoral markets, while sectors are predominantly net transmitters. Our study, which focused on different meme assets such as meme ETFs, corroborated these findings, suggesting that meme stocks and meme ETFs have minimal connectedness with sectoral markets and may thus serve as effective risk diversifiers for sectoral investments.

Conclusions

The phenomenon of meme stocks, driven by social media hype, has introduced new dynamics to financial markets, attracting significant attention from investors, regulators, and researchers. Our study aimed to investigate the impact of meme assets on sectoral dynamics using S&P 500's sector index funds as proxies. Through the application of the Granger causality test, we examined predictive relationships between selected meme assets and eleven sectoral indices. Our findings indicate that meme assets, including meme stocks and meme exchange-traded funds (ETFs), have a relatively limited impact on sectoral indices. Specifically, certain meme ETFs like MEME, ARKK, and SFYF exhibited predictive power over specific sectors such as technology, consumer staples, and communications. Conversely, our

results showed that various sectoral indices influenced the returns of meme assets, indicating that sectors tend to be transmitters of shocks rather than recipients. This conclusion is consistent with the study by Elsayed et al. (2024), which demonstrated that meme stocks and coins are primarily net receivers of shocks and are less integrated with sectoral markets. Our study adds to the literature by focusing on meme ETFs and corroborates the finding that meme assets have minimal connectedness with sectoral markets. This suggests that meme stocks and meme ETFs can offer diversification benefits for sectoral investments, providing valuable insights for investors and regulators. Our study also highlights the need for further research into the long-term implications of meme stock trading. As the landscape of meme stocks and ETFs continues to evolve, future studies should explore how these assets interact with different sectors over more extended periods and in various market conditions. Investigating the potential for meme assets to serve as a hedge against sector-specific risks could provide additional insights for portfolio management. In conclusion, the interconnectedness between meme stocks and sectoral markets is complex and multifaceted. While meme assets appear to have limited direct impact on sectoral indices, their role as shock receivers and potential diversifiers cannot be overlooked. As the financial markets continue to adapt to the influence of social media and retail investors, ongoing research and regulatory attention will be essential to maintain market stability and protect investor interests. By deepening our understanding of these dynamics, we can better navigate the challenges and opportunities presented by the rise of meme stocks and their influence on the broader financial system.

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Appendix

Appendix 1: Meme assets overview

Meme asset	Inception date	Investment style	Investment Strategy	Rebalance frequency
Roundhill Meme ETF (ticker: MEME)	December 8, 2021 (closed in December 2023, due to lack of investors' interest)	Passive Underlying index: Solactive Roundhill Meme Stock Index	Focused on meme stocks - securities that exhibit a combination of elevated social media activity and high short interest, both of which are indicators of market sentiment. At least 80% of the fund's net assets had to be invested in meme stocks. Non-diversified.	Bi-weekly
The SOFI Social 50 ETF (ticker: SFYF)	May 8, 2019	Passive Underlying index: SoFi Social 50 Index	Employs a wisdom of the crowd strategy by tracking the performance of the 50 most widely held U.S. listed stocks by individual investors on the SoFi Invest platform. Once the top 50 stocks are selected based on the number of accounts that invest in that stock, they are weighted according to the amount of money members have invested in the companies.	Monthly
The iShares MSCI USA Momentum Factor ETF (ticker: MTUM)	April 16, 2014	Passive Underlying index: MSCI USA Momentum SR Variant Index	Seeks to track the performance of U.S. large- and mid-capitalization stocks exhibiting relatively higher price momentum than the traditional market capitalization-weighted parent index.	Semiannual
VanEck Social Sentiment ETF (ticker: BUZZ)	March 2, 2021	Passive Underlying index: BUZZ NextGen AI US Sentiment Leaders Index (BUZZTR)	Seeks to track the performance of the 75 large cap U.S. stocks which exhibit the highest degree of positive investor sentiment and bullish perception, based on content aggregated from online sources including social media, news articles, blog posts and other alternative datasets.	Monthly
ARK Innovation ETF (ticker: ARKK)	31 October 2014	Actively managed	Aims to provide investors with exposure to innovative and disruptive companies that are leading advancements in areas such as artificial intelligence, robotics, genomic revolution, next-generation internet, and fintech innovation. At least 65% of its assets are channeled into domestic and foreign equity securities of disruptive innovation companies.	Daily
GameStop - GME	We used data from 01 January 2020	N/A	N/A	N/A

Source: Respective exchange traded fund website.