


# Effect of Social Media Posts on Stock Market During COVID-19 Infodemic: An Agenda Diffusion Approach

SAGE Open  
January-March 2024: 1–15  
© The Author(s) 2024  
DOI: 10.1177/21582440241227688  
[journals.sagepub.com/home/sgo](https://journals.sagepub.com/home/sgo)  


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## Abstract

This study assesses the impact of social media posts by different categories of opinion leaders on the stock market during the coronavirus 2019 (COVID-19) infodemic. After aggregating tweets ( $n = 302,806$ ) into diverse agendas based on posters' professional attributes, time-series analyses reveal that increased COVID-19 attention from media and public health agendas is linked to reduced stock prices. By contrast, emphasis on COVID-19 by political agendas tends to increase stock prices, contingent on public agenda sentiment levels due to negative bias. Additionally, the sentiment of the public agenda boosts stock prices through a chain mediating process. This study indicates that posts by politicians are more effective in preventing market crashes compared to those from media or public health experts. This research contributes to agenda-setting theory by introducing the agenda-diffusion approach, highlighting the distinct roles of opinion leaders, their dynamic effects, and the diffusion process. The findings provide insights for crisis management in future pandemics.

## Plain language summary

### How to prevent stock market crashes through communication: Differences in the impact of different categories of opinion leaders on stock prices during the crisis

Why was the study done? The COVID-19 outbreak resulted in a massive amount of information appearing on social media platforms. This triggered the 2020 stock market crisis. However, with so many social media posts from opinion leaders, we don't yet know the difference in their impact on the stock market and how. What did the researchers do? This study examines the impact of 302,806 tweets, categorized into political, media, and public health groups, on the stock market during the COVID-19 infodemic. Each tweet was aggregated based on the professional attributes of the sender, examining how different categories of opinion leaders influenced stock market. What did the researchers find? Results indicate that tweets from media and public health professionals generally correlate with a decrease in stock prices. While political tweets often lead to a stock price increase, this effect in periods of low sentiment is stronger than higher sentiment. Additionally, the sentiment of the public agenda boost stock prices through step-to-step process: sentiment-media panic-media hype-stock prices. What do the findings mean? Different categories of opinion leaders have different impacts on the stock market, not all the same. Politicians are more effective in preventing market crashes compared to those from media or public health experts. Surprisingly, the media and public health experts are releasing information to guide the population against the virus, though, which could play up fears and threaten the stock market. Therefore, future crisis management could prevent financial market collapses by intervening in the communication process of different categories of messages.

## Keywords

COVID-19 infodemic, social media, posts, agenda diffusion, stock prices, crisis

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## Introduction

Coronavirus (COVID-19) outbreak has wreaked havoc globally. Overburdened hospitals, staggering death tolls, and transportation disruptions, coupled with the initial limited understanding of COVID-19, have plunged people into deep fear. Urgency encourages people to seek, share, and post information on social media. However, this triggered an infodemic (information pandemic), in which there is too much information, including false or misleading information, on social media. It caused confusion and spillover effects. For example, March 2020 witnessed one of the most dramatic stock market crashes in history, with the Dow Jones Industrial Average (DJIA) plummeting by 6,400 points, or approximately 26%, in just four trading days (Mazur et al., 2021). Strong negative information was projected to collapse the U.S. stock market by 2020 (Moalla & Dammak, 2023; Ozili & Arun, 2023). Because infodemics can affect more than just the financial world, the World Health Organization (WHO) calls for research on the COVID-19 infodemic and its consequences across various fields (WHO 2023).

Pandemics (similar to the Spanish Flu of 1918 and the Black Death of the 14th century), are very rare. Therefore, knowledge about how information flows during pandemics and how it affects society is limited (Wagner, 2020). COVID-19 infodemic, as an information crisis, occurs primarily on social media. When social media coverage of an issue about COVID-19 increases, the salience of COVID-19 also increases (Scheufele, 2000). This is true not only for the general public but also for financial experts and investment markets. Their assessments of the current economic situation and expectations are largely determined by their knowledge derived from many sources, including social media. These decisions lead to changes in investment decisions and affect stock market volatility (Nepp et al., 2022). In other words, news content drives market sentiment (Shiller, 2015) and trading behavior.

Unfortunately, information (news) on social media is mostly negative (i.e., fearful) (Lwin et al., 2020; Naseem et al., 2021). This negative information affects investor sentiment (W. Yang et al., 2017), leading to increased anxiety (Garfin et al., 2020), fear, and panic (Atri et al., 2021). Ultimately, negative information is transferred to the financial markets through panic-stricken investors (Nepp et al., 2022). Furthermore, more negative sentiment generates greater attention, creating a vicious cycle of information crisis.

Research on the relationship between information (news) and finances shows that COVID-19 information (news), sentiments, panic, and media hype affect the stock markets (Deng et al., 2023; Huynh et al., 2021; X. Li, 2021; Szczygielski et al., 2023; Valle-Cruz et al., 2022; Zargar & Kumar, 2023). However, most studies have

focused on the financial perspective rather than the information (news) diffusion process. Thus, when the next crisis occurs, we will not know how to prevent stock markets from collapsing by interrupting the information (news) diffusion process. Thus, a new approach based on communication science is required to understand the information (news) diffusion process that affects trading behavior.

Agenda-setting (M. E. McCombs & Shaw, 1972) and the diffusion of innovations (Rogers, 2003) focus on the role of influential opinion leaders or early adopters in shaping public opinion. However, owing to the abundance and diversity of opinion leaders, conflicting and unprofessional information from the media and political and public health opinion leaders often compete for viewers' attention. Regrettably, few studies pay attention to opinion leaders' agendas. Even if studies focus on agendas of opinion leaders (A. Chen et al., 2022; Gollust et al., 2020; Mourad et al., 2020), they do not differentiate between the different types. Importantly, different types of agenda can shape different models of financial communication in times of crisis.

Clearly, a theoretical gap in financial communication models exists regarding how (political, media, and public health) agendas influence investors' trading behavior during COVID-19 infodemic on social media. To what extent do opinion leaders' social media posts affect the stock market, and do different types of agendas have different effects?

To fill this gap, we select the United States for data collection because of its position as the world's largest financial market, where market fluctuations may potentially have spillover effect globally. We developed the concept of *agenda diffusion* based on agenda-setting. Agenda-diffusion is defined as the dynamic process by which topics or issues of diverse agendas spread and gain prominence across social networks. It investigates the diffusion process of how agendas affect the public, including the types of agendas, dynamic effects, and diffusion mechanisms. (Brosius et al., 2019; Weimann & Brosius, 2017). Agenda-diffusion relies on the notion that communication affects social networks (Weimann & Brosius, 2017). Thus, the dynamic effects of diverse agendas (attention and sentiment) on the stock market represent different diffusion processes on social media platforms.

This study is essential and urgent for several reasons. First, the WHO expressed concerns about online infodemic during the COVID-19 pandemic. This study addresses the infodemic problem from both communication and behavior science perspectives, making valuable contributions to understanding the COVID-19 infodemic. Second, this study introduces the concept of agenda-diffusion to extend the agenda-setting approach, offering a new theoretical approach to explain the

COVID-19 infodemic. Finally, this study provides fresh insights into the role of opinion leaders in preventing stock market collapse by analyzing the relationship between indicators of diverse agendas and stock behavior. Thus, this study contributes to the literature and enhances our understanding of agenda-diffusion during infodemic crises, and has important implications for policymakers and researchers alike for intervening agenda (aggregation of influential opinion leaders' posts) diffusion process in crisis communication to prevent stock market collapse.

COVID-19 pandemic seems to be over, even though the COVID-19 is still present. However, in the future, new pandemics caused by other viruses (bird flu, monkeypox) may emerge. This study provides insights for understanding the relationship between public information and financial traders' decisions, which may be relevant for future global crises.

In Agenda Diffusion section, we develop an agenda-diffusion approach to address the three limitations of current agenda-setting: setters, dynamic influences, and diffusion processes. We use the agenda-diffusion approach to show COVID-19 agendas on stock trading behavior differs according to the role of opinion leaders (Diverse Opinion Leaders section), dynamic effects (Dynamic Effects section), and diffusion processes (Diffusion Process section).

## Literature Review

The literature review comprises four parts that address the theoretical gaps outlined above. First, it reviews the limitations of agenda-setting in the context of social media communication, and develops an agenda-diffusion approach. Second, it explores how the attention (first level) and sentiment (second level) attributes of agenda-diffusion directly affect stock trading behavior. Third, it examines the dynamic (moderation) effects of agenda-diffusion. Fourth, it investigates agenda-diffusion as a process by examining its direct and indirect effects.

### Agenda Diffusion

The core assumption of agenda-setting is that the media has the ability to shape public opinion by determining which issues are given more attention. Studies have shown that there are three levels of agenda-setting. The first level (M. E. McCombs & Shaw, 1972) focuses on the salience of an issue or topic. The second level (M. McCombs, 2005; Weaver, 2007) focuses on the salience of an issue's internal attributes. The third level focuses on network agenda-setting, suggesting that the salience of network relationships between issues and attributes can also be transferred from the media to the public

agenda (Guo & McCombs, 2015). However, online platforms have changed the media environment dramatically, and thus challenged the basic assumption of agenda-setting (Weimann & Brosius, 2017). In particular, social media not only adds a layer of complexity to the dynamics of agenda-setting but also has the potential to change the nature of the agenda beyond what traditional media were able to (Gilardi et al., 2022).

The first challenge is changing agenda-setters. Traditional agenda-setting suggests that the news media can set a public agenda. However, social media has changed the concept of the media agenda, extending the definition of news sources and makers. Networked opinion leaders (news makers) use social media to source and distribute their own information (Newman et al., 2013) without news media. As a result, opinion leaders have become broader agenda setters, similar to news media, such as the former U.S. President Donald Trump (Lewandowsky et al., 2020). Many agenda-setting studies (Z. Chen et al., 2019; Gilardi et al., 2022; Lewandowsky et al., 2020; Su & Borah, 2019; F. Yang & Sun, 2021) have focused on single media/single issues, multiple media/multiple issues and all variations, and static/dynamic issues. At the aggregate level, the influence of a single issue (such as COVID-19) is not fully understood in the context of different types of agenda setters (opinion leaders).

The change in the agenda-setter leads to a second challenge: dynamic setting effects. During the press media era, traditional agenda-setting assumes that mass media set agendas for individual opinion leaders, and individual opinions can also influence the media agenda (Rogers & Dearing, 2012). During this era, social media has transformed passive opinion leaders into active content generators (F. Yang & Sun, 2021). These leaders now post information based on their own interests. Subsequently, these social media posts influence journalists' coverage decisions, affecting the events they cover, the sources they use, the quotes they present, and the background information they rely on to frame an issue (Parmelee, 2014). As a result, agenda-setting is no longer viewed solely as a static process, such as a top-down process from the news media to the audience or a bottom-up process from the audience to the news media. Instead, it is viewed as a dynamic interplay (Weimann & Brosius, 2017). Most of the previous research on dynamic effects has focused on agendas (first level), such as media (Gilardi et al., 2022), politicians (Lewandowsky et al., 2020), and personal (Z. Chen et al., 2019) agendas. Few studies have focused on the dynamic effects of agenda sentiment (second level), which may affect human mental health (Aslam et al., 2020; Lekkas et al., 2022) and (trading) behavior in times of crisis.

The third challenge is understanding agenda-setting as a dynamic communication process. Traditional agenda-

setting requires time for the media agenda to be absorbed and accepted as a public agenda (Weimann & Brosius, 2017). However, the instantaneous and ubiquitous nature of social media communication disrupts the traditional timeline assumptions. In a social media environment, opinion leaders post and share information whenever and wherever they prefer. Users can read, like their favorites and comments, and share whenever and wherever they like. Thus, agenda-setting is a continuous process.

Consequently, audiences encounter information outside a fixed linear timeline, marking a departure from the regimented scheduling observed in traditional media. This evolving dynamic challenges the conventional correlation between news items and their timestamp, making content relevance less about “when setting” and more about “how diffusion” (Brosius et al., 2019). In this scenario, the impact of the agenda shifts from being solely influenced by media gatekeepers to being driven by network homophily (the formation of social ties due to matching individual traits [Shalizi & Thomas, 2011]) or social contagion (social influence, temporal relationship between the behavior of individuals at time and any [potential] neighbors at the previous time point) (Rogers, 2003; Shalizi & Thomas, 2011) and diffusion in the sociocentric network (Al-Taie & Kadry, 2017; A. Yang & Saffer, 2019). In short, within social networks, it is not just publishing time, content, or opinion leaders that shape an agenda. Instead, emphasis is placed on how content is adopted and diffused in a sociocentric network. Thus, the process is more aptly described as agenda diffusion (Brosius et al., 2019).

In summary, the original agenda-setting approach used to study media effects was limited to setters, dynamic effects, and communication processes. In the realm of social networks, the distinction between media (disseminators) and audiences (receivers) has faded. Instead, it is evolving toward the idea that “the effect of communication is communication” (Weimann & Brosius, 2017). Thus, within the context of the COVID-19 infodemic, the influence of social media posts on stock markets represents a process of communicating the COVID-19 infodemic. Therefore, developing an agenda-diffusion approach not only contributes to expanding the theoretical approach of agenda research but also to crisis management. Specifically, we develop an agenda-diffusion approach to fill the theoretical gap in how diverse the COVID-19 agenda’s affect financial stock markets (human trading behavior) during the COVID-19 infodemic. We achieve this by focusing on the different effects of attention (first level) and sentiment (second level) of agendas from the perspectives of diverse opinion leaders (Diverse Opinion Leaders section), the dynamic effect (Dynamic Effects section), and the diffusion process (Diffusion Process section).

### *Diverse Opinion Leaders*

The first level of agenda-diffusion is similar to agenda-setting. In the COVID-19 infodemic, diverse agendas often become contradictory due to differences in backgrounds and interests (cf. U.S. President Donald Trump’s tweets conflict with news media narratives). Investors base their decisions not only on basic market information, but also on sentiments and feelings in society and politics (Huynh et al., 2021; Tiwari et al., 2022). Investors may develop fear and uncertainty owing to the diffusion of conflicting agendas. This conflicting environment hampers their capacity to identify credible information, which in turn affects their trading behavior. For example, some studies (Strauß et al., 2018) demonstrate that news attention generally positively influenced stock markets before COVID-19 crisis. However, after the COVID-19 pandemic outbreak, news attention negatively affects stock markets, but it positively affects media panic (Burggraf et al., 2020). Consequently, researchers suggest that this change in direction correlates with the increased attention paid to COVID-19 in the media and political agendas (Huynh et al., 2021; X. Li, 2021; Valle-Cruz et al., 2021).

This increased attention makes it difficult for investors to seek reliable information and make stock-informed trading decisions on social networks. To streamline information processes and make sense of the vast attention, people have turned to trusted professional opinion leaders on social media for clarity (Aslam et al., 2020; Mourad et al., 2020), such as politicians, media, and public health experts (Evanega et al., 2020; Naeem & Bhatti, 2020). This inclination implies that information rooted in distinct professional disciplines tends to naturally group into network homophily (Shalizi & Thomas, 2011; A. Yang & Saffer, 2019). Consequently, news media and politicians’ social media posts aggregate traditional agendas (M. McCombs & Valenzuela, 2020), mirroring the concerns and views of professional opinion leaders. The infodemic crisis in the United States is a communication crisis in media, politics, and public health (Gollust et al., 2020).

In discussions about communication crises, scholars often propose that “the more you know, the less you fear” (López Peláez et al., 2020). However, this may not always be true because humans are not always rational. When the media and political agendas hype the topic of COVID-19, the amplified attention on COVID-19 generates uncertainty, undermines investor confidence, and induces fear, ultimately leading to stock selling behavior and resulting in a decline in stock prices. For example, initially, a prominent political leader asserted that the pandemic was under control. However, the very next day, this leader announced a significant travel ban involving Europe, without addressing the economic and

healthcare responses sought by investors (Horowitz, 2020). This announcement led to a significant market reaction, resulting in a 1,200 point drop (5.1%) in the DJIA. Thus, considering the dynamic diffusion process, the media and political agendas of traditional agenda categories may lead to lower stock prices. Considering this, we propose

*Hypothesis 1a/b (H1a/b): The higher the attention to COVID-19 in media (1a) and political (1b) agendas, the lower the stock prices, at the onset of the infodemic.*

In addition to the traditional agenda categories, the public health agenda during the COVID-19 crisis is noteworthy. A study using Twitter-based big data analysis revealed a high public demand for reliable information from public health experts (Mourad et al., 2020). Reliable information is crucial for controlling and mitigating the spread of false or misleading information on social media (Zarocostas, 2020). Researchers have recommended the use of public health information professionals for fact-checking to combat infodemics (Naeem & Bhatti, 2020). Most previous studies have focused on the characteristics underlying expert information; however, the diffusion effects of these experts have received little empirical attention. Owing to the varying stock market reactions to COVID-19 information (Zainuri et al., 2021), the response to reliable information may not be as positive as previously expected (López Peláez et al., 2020). Thus, when a public health agenda influences stock trading behavior, experts may not always have a positive impact one might anticipate.

The experts' information guides investors on how to protect themselves from COVID-19, but which information maybe unintentionally trigger stock declines. The social media posts of experts often represent evidence-based science. However, investors pay attention to their scientific information not only because of the need to fight the disease but also for investment decisions. An abundance of expert information may make investors feel that scientists are "fearful" of COVID-19. Furthermore, studies have shown that excessive media exposure during a health crisis is associated with greater fear and worry (Sasaki et al., 2020), and that repeated exposure negatively impacts mental health (Fukasawa et al., 2021), particularly during the COVID-19 pandemic (Garfin et al., 2020). The increased attention paid to the public health agenda can disrupt investor psychology. Instead of reassuring investors, the influx of expert information might be perceived not only as a signal of imminent threats but also as a source of future uncertainty. This heightened focus on public health can instill fear among investors, potentially leading to lower stock prices. Thus, we propose

*Hypothesis 1c (H1c): The higher the attention on COVID-19 in public health (1c) agendas, the lower the stock prices, at the onset of the infodemic.*

The second level of agenda-diffusion is sentiment, which is analogous to the attribute aspect of agenda-setting. Both behavioral finance and communication studies (Filip & Pochea, 2023; T. Li, Chen, et al., 2023; Strauß et al., 2018) emphasize that sentiments within agendas mold investor perceptions and decision-making. This influence subsequently manifests in the market as herd behavior.

Herd behavior describes the consistency of actions within a group, in which individuals often mimic the actions of others. This phenomenon arises because decisions tend to be influenced more by the prevailing market consensus than by fundamental market data (Chang et al., 2000). Thus, the sentiment prevalent in agendas can guide investors' expectations, prompting them to make decisions that align with the dominant market sentiment. For instance, if the majority sentiment is positive, it often translates to rising stock buying behavior, and vice versa (Shih et al., 2022; Strauß et al., 2018).

There is scholarly consensus that sentiment-driven herd behavior influences investors' trading behavior (Melas & Michail, 2023). However, in the age of social media, especially during the COVID-19 infodemic, investors often simultaneously expose themselves to media, politics, and public health agendas. Previous studies (Filip & Pochea, 2023; T. Li, Chen, et al., 2023; Strauß et al., 2018) mostly focus on the effect of sub agenda's sentiment on trading behavior. It is not known whether multiple sub-agendas work together to shape the public agenda and influence herd behavior. Positive sentiment can trigger herd optimism, leading to climbing stock prices, and the opposite effect with negative sentiment. With this understanding, we propose:

*Hypothesis 2: The higher the negative sentiments about COVID-19 in public agenda (aggregated by media, political and public health sub-agendas), the lower the stock prices, at the onset of the infodemic.*

### Dynamic Effects

The second challenge in agenda research is dynamic effects. The dynamic effects of agenda-diffusion refer to the interaction between the types of agendas (Gilardi et al., 2022; Weimann & Brosius, 2017). Research has found dynamic effects of first-level attentional shifts across types of agendas (Z. Chen et al., 2019; Gilardi et al., 2022; Lewandowsky et al., 2020). Whether similar dynamics apply to second-level sentiment within agendas has not been investigated yet.

A pivotal finding of previous research is the asymmetry between the effects of negative and positive events. Negative events often have more significant consequences than positive events of comparable magnitudes (Baumeister et al., 2001). For instance, negative information tends to require longer processing time and plays a more influential role in shaping impressions (Reyes, 2019). Translating this into the realm of stock trading behavior, it is evident that negative news exerts a more potent impact on trading behavior (Huynh et al., 2021) than positive news (Suleman, 2012). This tendency to assign more weight to negative information is often termed negativity bias.

The concept of negative bias can potentially drive dynamic (moderating) effects within agendas. This bias arises due to the finite nature of investor attention. When faced with decisions or predicting herd behavior, negative information disproportionately influences the overall evaluation (Akhtar et al., 2011). Retail investors exhibit a more pronounced negative bias (Reyes, 2019). The prevailing economic and political uncertainties stemming from the COVID-19 pandemic have further exacerbated this bias (Cepoi, 2020). Given this, the attention that an agenda receives might affect the stock market moderated by sentiment within that agenda. Thus, this study proposes the following hypotheses:

*Hypothesis 3 (H3): Negative sentiments amplify the effect: attention of media (3a), political (3b), and public health (3c) agendas' effect on stock prices.*

### Diffusion Process

For the third challenge, the diffusion process, we can infer from previous researches (Garfin et al., 2020; Huynh et al., 2021; Maia et al., 2021; Sasaki et al., 2020) a chain mediation or mechanism by which the sentiment of the public agenda affects stock trading behavior. While not directly emphasized, studies suggest that heightened public agenda exposure during an infodemic crisis amplifies fear among individuals (Garfin et al., 2020; Sasaki et al., 2020). This fear influences the public's perceived risk (Huynh et al., 2021) and this perceived risk likely arises from the potential for widespread panic, which is worsened by prevailing uncertainty in the flow of information (Maia et al., 2021). An uptick in negative sentiment within the public agenda may diffuse into the media, escalate fear, amplify perceived risk, and ultimately trigger media panic as a dynamic process.

The second diffusion process is the effect of media panic on media hype. During the COVID-19 pandemic, social media platforms have been overwhelmed by vast amounts of information (Hong & Kim, 2020). Media hype represents elevated interest among Internet users

triggered by notable events (Pang, 2013). Research has shown that panic influences media hype (Berger & Milkman, 2012; Pang, 2013). Media panic during an infodemic crisis may stimulate discussions and amplify media hype.

Third, media hype affects stock trading behavior. Increased media hype implies more information on the public agenda, which affects decision-making judgments (Aljanabi, 2023). Cognitive theory suggests that investors possess limited information-processing capabilities (Bernales et al., 2022), especially in the COVID-19 information environment (Priem, 2021). Consequently, heightened media hype obstructs investors' ability to make informed decisions amid information overload (Hong & Kim, 2020), leading to increased uncertainty and potentially driving stock prices downward (X. Li, Su, et al., 2022).

Although studies (Cevik et al., 2022; Dhar & Bose, 2020; Naseem et al., 2021) suggest that negative sentiment during COVID-19 results in decreased stock returns or prices, the specific mechanism remains unidentified. Based on the above observations, this study proposes that a chain-mediated effect may occur when the sentiment of agenda negatively impacts stock prices. This diffusion path may not only lose retail investors money, but also be an opportunity for institutional investors to benefit from the information crisis (e.g., hedge funds use this mechanism to short selling). Thus, we expect that:

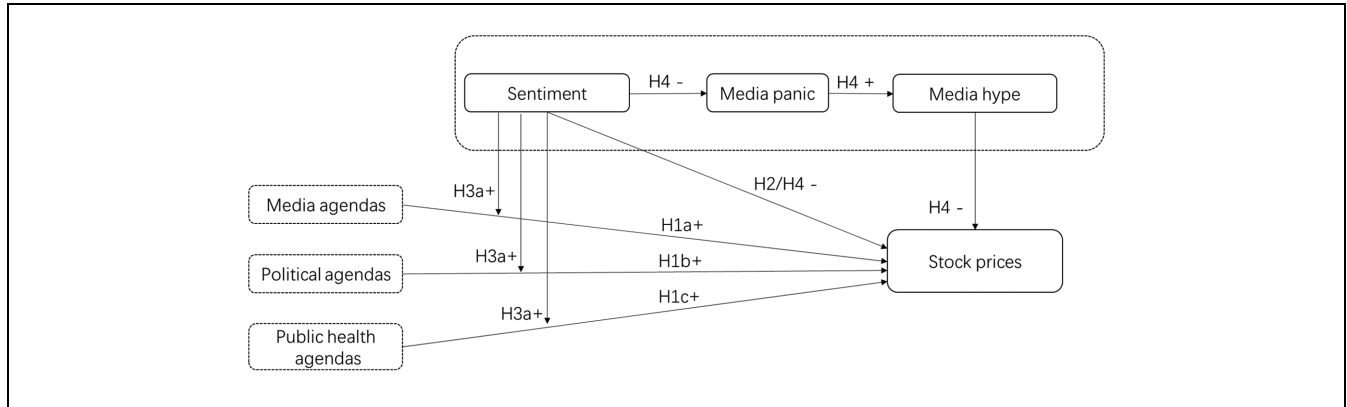
*Hypothesis 4: Institutional investors may utilize the chain mediation effect in agenda diffusion during infodemic crisis for short sell: increased negative sentiment leads to greater media panic, heightened media panic escalates media hype, which then triggers lower stock prices.*

Figure 1 shows the proposed theoretical framework about agenda-diffusion into stock trading behavior.

## Methods

### Data

The United States was selected to examine the impact of various agendas on stock prices because of its position as the world's largest financial market, where market fluctuations may potentially have a spillover effect globally. The focus is on large U.S. companies, central to multiple industrial sectors, to provide a comprehensive view of market behavior. We collected DJIA stock price data from Yahoo Finance. As a well-established index representing the performance of large companies, DJIA offers a relevant and robust measure for analyzing stock market dynamics in a globally impactful context.



**Figure 1.** Integrated theoretical framework.

To collect data regarding the independent variable agenda (aggregated social media posts), we executed a two-step process using X data. Initially, leveraging existing rankings (see Supplemental Appendix), we identified opinion leaders on Twitter, classifying them into politicians (ranging from prominent figures such as @Trump, @ President Biden, to less visible ones such as other Federal leaders, Senate leaders, and House of Representative,  $N = 44$ ), media (CNN, Fox News, New York Times, Washington Post, etc.,  $N = 65$ ), and public health (WHO, CDC, Washington Department of Health, etc.,  $N = 245$ ). Subsequently, we employ the Twitter Academic API (Barrie & Ho, 2021) to collect tweets from the identified opinion leaders.

Additionally, we used the Media Hype Index and the Panic Index from the RavenPack database, a renowned platform tracking COVID-19 information proliferation in real time across media outlets such as Dow Jones Newswires and Wall Street Journal (RavenPack, 2023).

All data cover the entire period between March 11, 2020, and March 11, 2021, the first year of the pandemic, as defined by the WHO.

## Measurements

**Dependent Variable.** The dependent variables are stock prices, which are measured through the daily closing price of the DJIA. The DJIA is a general indicator of the performance of important businesses in the United States by weighting the stock prices of large U.S. companies in sectors including financial services, the food industry, and retail, thus providing a composite representation of the U.S. stock market. Thus, higher DJIA values indicate higher levels of trust in the stock markets and economy during the COVID-19 infodemic.

**Thematic Attention.** We aggregated tweets daily and thematically in terms of COVID-19-related posts

( $n = 302,806$ ) using specific keywords (see Supplemental Appendix). The daily totals of opinion leader tweets under specific categories reflect the thematic attention of political, media, and public health agendas.

**Sentiment Analysis.** Sentiment was measured using a dictionary approach. After preprocessing the tweets (e.g., removing stop words and special characters, and converting all text to lowercase), the AFINN lexicon was used (Nielsen, 2011) to assess the sentiments in the tweets. AFINN is a list of precompiled sentiment scores for English words and phrases. Each word or phrase has been rated on a scale from  $-5$  (very negative) to  $+5$  (very positive). Words in the tweets were merged using the AFINN lexicon to compute the sentiment attributes of each tweet. Previous studies (Al-Shabi, 2020; Khan et al., 2021; Sadhu et al., 2022) have shown that AFINN performs well at labeling the sentiment of tweets. The level of sentiment was established by subtracting the negative score of each tweet from its positive score. Subsequently, the daily sentiment score was based on the sum of the difference in scores for each thematic agenda. The higher the aggregate positive score, the more positive the tweets were on a specific date and theme.

**Conditional Factors.** We used the daily Panic Index to measure media panic, which measures the level of news chatter that refers to panic, hysteria, and coronavirus (RavenPack, 2023). With values ranging from 0 to 100, the higher the index value, the more references to panic were found in the media. In addition, we used the daily Media Hype Index to measure the percentage of news mentioning COVID-19 with values ranging between 0 and 100 (RavenPack, 2023). To assess the relative importance of independent variables, all variables were standardized by Z-scores.

**Table 1.** Autoregressive Distributed Lag and Moderating Role Analysis.

Variable	Augmented Dickey-Fuller test	Phillips- Perron test	Lags	Main effects Model 1	Moderating effects			
					Model 2	Model 3	Model 4	
Dow Jones industrial average <sub>t</sub>	−4.601***	−4.591***	Lag(1)	0.858***	0.840***	0.832***	0.855***	
			Lag(2)	0.281***	0.294***	0.305***	0.284***	
			Lag(3)	−0.182***	−0.181***	−0.184***	−0.182***	
Media agenda attention <sub>t</sub>	−3.466***	−6.086***	Lag(0)	−0.040**	−0.051**	−0.058***	−0.042**	
Political <sub>t</sub> agenda attention <sub>t</sub>	−2.947**	−6.949***	Lag(0)	0.114***	0.113***	0.100**	0.112***	
Public health <sub>t</sub> agenda attention <sub>t</sub>	−3.030**	−7.868***	Lag(1)	0.032**	0.031**	0.032**	0.032**	
			Lag(0)	−0.080**	−0.082**	−0.071*	−0.079*	
			Lag(0)	0.0266	0.031*	0.023***	0.026***	
Level of sentiment <sub>t</sub>	−2.345**	−7.252***	Lag(1)	0.021	0.021***	0.018***	0.020***	
			Lag(2)	0.003	0.001***	0.006***	0.004***	
			Lag(3)	0.060***	0.059***	0.061***	0.060***	
			Lag(4)	−0.037**	−0.034**	−0.038**	−0.0371**	
Media agenda diffusion <sub>t</sub> * Level of sentiment <sub>t</sub>					−0.010			
Political agenda diffusion <sub>t</sub> * Level of sentiment <sub>t</sub>						−0.018*		
Public health agenda diffusion <sub>t</sub> * Level of sentiment <sub>t</sub>							−0.002	
Prob. (LM)				0.458				
Prob. (ARCH)				0.057				

\*\*\*, \*\*, and \* denote the significance at 1%, 5%, and 10% levels.

## Analysis

First of all, the results of the Granger causality test show that there is a bi-directional Granger causality between the independent and dependent variables (see Supplemental Appendix). After that test, an autoregressive distributed lag (ARDL) model is used as our proposed theoretical model. ARDL assumes that all variables are endogenous and accommodates the different effects of various variables at different lags. As recommended by previous studies (Nkoro & Uko, 2016; Shrestha & Bhatta, 2018) the ARDL model requires a cointegration test and residual diagnostics to ensure a good fit and that the investigated variables are cointegrated without serial correlation or heteroskedasticity problems.

Regarding the moderating role of the level of sentiment, our study analyzed the moderating effects by creating interaction terms linking agenda-diffusion's attention to media, politics, and public to the level of sentiment. In addition, we assessed chained mediating effects using a bootstrap method by selecting 5,000 bootstrap samples with 95% bias-corrected confidence intervals (Hayes, 2013).

## Results

To analyze the stationarity of the dependent and independent variables, the study employed two tests: the Augmented Dickey–Fuller (ADF) and Phillips–Perron

(PP) tests, both of which are designed to detect unit roots in time-series data. According to the results displayed in Table 1, both the dependent and independent variables were stationary at their respective levels ( $p < .05$ ). This indicates a significant level of stationarity and suggests that the time series does not have a unit root, which is a common assumption in many time-series models.

Akaike Information Criterion (AIC) was employed to select lags for the model. This criterion helps determine the optimal number of lags to be included in a time-series model to balance the trade-off between fit and complexity. The study identified that including the lags [3, 0, 1, 0, 4] for the Dow Jones Industrial Average (DJIA), Media Agenda Attention, Political Agenda Attention, Public Health Agenda Attention, and Level of Sentiment, respectively, improved the model. These lags were incorporated because they statistically enhanced the model.

Several diagnostic tests were conducted to assess the robustness of the statistical models presented in this study. The cointegration diagnostics indicates a significant long-term equilibrium relationship between the examined variables. This is evidenced by the F-statistic (5.277), which surpasses the critical value at the 1% level of significance. This finding signifies that the variables in question do not drift apart or converge randomly, but rather move in tandem over time, reflecting a common stochastic trend. This ensures that the variables maintain a consistent relationship with one another over the duration being studied.



**Table 2.** Mediation Effects Analysis.

Variables	Media Panic Index	Media Hype Index	Dow Jones Industrial Average	Dow Jones Industrial Average
Level of sentiments	-0.489*** (-8.865)	-0.280*** (-7.101)	0.642*** (13.243)	0.221*** (5.274)
Panic Index		0.667*** (16.938)		-0.142** (-2.536)
Media Hype Index				-0.580*** (-9.426)
R-squared	0.239	0.706	0.412	0.724
Adjusted R-squared	0.236	0.704	0.41	0.721

\*\*\*, and \*\* denote the significance at 1% and 5% levels.

In addition to cointegration diagnostics, the Breusch–Godfrey Lagrange multiplier (LM) test and Autoregressive Conditional Heteroskedasticity (ARCH) test were applied to evaluate other potential issues within the model. The LM test result ( $p = .458$ ) suggests that serial correlation is not a concern, indicating that the residuals of the model are not influenced by past values, which can often lead to inaccurate estimates. Similarly, the ARCH test ( $p = .057$ ) shows no evidence of heteroskedasticity, indicating that the error variance in the model is uniform across the different levels of the explanatory variables. The absence of serial correlation and heteroskedasticity further substantiates the validity of the model, confirming that it is well-constructed and reliable for the interpretation of the variables' behavior over time.

Hypothesis 1 (H1) proposed that heightened attention to COVID-19 in the media (H1a) and politics (H1b) would lead to lower stock prices, while increased attention to public health (H1c) would similarly result in a decline in stock values, at the onset of the infodemic. Our findings revealed mixed outcomes. Media attention to COVID-19 shows a significant negative correlation with stock prices ( $b = -0.040$ ,  $p < .05$ ), which aligns with H1a. However, political attention reveals an unexpected positive relationship with stock prices at lag (1) ( $b = 0.114$ ,  $p < .01$ ) and lag (2) ( $b = 0.032$ ,  $p < .05$ ), contradicting H1b. In contrast, public health attention corresponded to a decrease in stock prices ( $b = -0.080$ ,  $p < .05$ ), supporting H1c.

Hypothesis 2 (H2) considers the impact of negative sentiment on stock prices at the onset of the infodemic. Our results show that sentiment has a complex relationship with stock prices, with negative sentiment leading to a decrease ( $b = -0.037$ ,  $p < .05$  in Lag [4]) and an increase ( $b = 0.060$ ,  $p < .01$  in Lag [3]). These results suggest that increased negative sentiments on the public agenda correlate with a failure (on the third day) and a rise (on the fourth day) in the DJIA. These mixed results partially support H2, indicating that the effect of public sentiment on stock prices may vary over time.

Regarding sentiments, Model 1 in Table 1 reveals that sentiment has both positive ( $b = 0.060$ ,  $p < .01$  for in Lag [3]) and negative ( $-0.037$ ,  $p < .05$  Lag [4]) effects on

the DJIA, suggesting that increased negative sentiments on public agenda correlate with a failure (on the third day) and a rise (on the fourth day) in the DJIA, at the onset of the infodemic. Thus, the results partially support H2 that more negative sentiment on public agenda leads to more stock-selling behavior.

Our study proposes Hypothesis 3 (H3) regarding the moderating role of sentiment. However, the interaction terms in Models 2 and 3 were not significant, leading to a lack of support for H3a (media) and H3b (politics). In addition, the interaction term between political agenda attention and sentiment level is significant ( $b = -0.018$ ,  $p < .10$ ), indicating that as sentiment becomes more positive, the uplifting effect of political attention on the DJIA weakens. By contrast, when sentiments are more negative, the positive influence of political attention on the DJIA becomes even stronger. Thus, in times of heightened negativity, the stock-boosting effect of political attention is accentuated. Thus, H3c was supported.

Finally, Hypothesis 4 (H4) predicts that increased negative sentiment leads to more media panic, which escalates media hype and triggers lower stock prices. Table 2 shows the indirect effects: a higher level of sentiment negatively affects the Media Panic Index; a higher Media Panic Index positively affects the Media Hype Index; and a higher Media Hype Index negatively affects the DJIA. Thus, the mediated path “Level of Sentiment  $\Rightarrow$  Media Panic Index  $\Rightarrow$  Media Hype Index  $\Rightarrow$  Dow Jones Industrial Average” is statistically significant ( $b = 0.189$ ,  $p < .001$ , see Table 3). This finding supports the chain-mediated effect proposed in H4.

## Discussion

This study explores how agendas affect stock trading behavior through the public communication of opinion leaders in different fields during the COVID-19 infodemic.

Previous research has emphasized that authoritative and trustworthy news media should release information quicker in times of crisis to counteract information crises and satisfy people's needs for information (Evanega et al., 2020; Eysenbach, 2020; Naem & Bhatti, 2020). However, the results for Hypothesis H1a indicate that

**Table 3.** Chain Mediation Total Effects.

Path	Effect	SE	LLCI	ULCI	z	p
Level of sentiment ⇒ Media Panic Index ⇒ Media Hype Index ⇒ Dow Jones Industrial Average	0.189	0.030	0.138	0.2555	6.383	.000

Note. BootLLCI and BootULCI refer to the lower and upper limits of the 95% interval of Bootstrap sampling, respectively.

increased attention to the media agenda leads to lower stock prices. This may be because the previous perspective ignored the fact that the news media's extensive negative coverage may shape public opinion (M. McCombs, 2005). When influential people express their views, some news outlets may feel compelled to report their views even though journalists may not agree with them (Evanega et al., 2020; Viswanath et al., 2020). Thus, news media may unintentionally contribute to the amplification and mainstreaming of misinformation (Dhawan et al., 2021). Owing to their high credibility and wide coverage, authoritative media have the potential to exacerbate panic through extensive coverage. This panic may trigger lower stock prices and further increase the risk of stock market collapse.

Contrary to Hypothesis H1b, attention to political agendas was associated with higher stock prices. This finding implies that political agendas pacify investors' emotions and prevent them from experiencing panic. The reason behind this may be because politicians are the social governors and policymakers. Investors may perceive increased political agenda attention as stability, policy clarity, or some other positive factor. Thus, politicians' attention may satisfy investors' expectations of future policies, reduce investor panic, and avoid selling behavior. Indeed, we agree with previous studies that politicians release misleading information based on their political positions (Evanega et al., 2020). However, from another perspective, this stabilizes the stock market.

Previous studies have suggested that scientific information from public health experts plays an important role in the fight against diseases (Eysenbach, 2020; Mourad et al., 2020; Naeem & Bhatti, 2020; van Dijck & Alinejad, 2020; Ye et al., 2021). However, the results for Hypothesis H1c show that increased attention to the public health agenda leads to lower stock prices. This may be related to the fact that scientific information is intended to fight viruses rather than being based on society-wide crisis management. An increase in scientific information may trigger investors to consider experts as emphasizing the dangers of the virus (Lavazza & Farina, 2020). Dangerous signals from highly reliable experts may accidentally trigger investors to panic and promote selling behavior. In addition, it may also give opportunities to institutional investor that are intentionally selling short. Consequently, public health experts can disrupt

the stock market, although this is not their intention. This finding is contrary to those of previous studies that unidirectionally acknowledged the contribution of public health experts; however, we argue that their impact is double-edged.

Results of agenda attention in this study contradict the notion "the more you know, the less you fear" (López Peláez et al., 2020). Previous arguments have been based on the idea that humans are rational. However, humans, as animals distinguished from machines, are not always rational. Therefore, the more one knows, maybe the more one fears, particularly when the media is presenting contradicting information. On one side, the prevalent fear leads to a wave of selling among irrational (retail) investors, who react impulsively to market uncertainties. Conversely, rational investors, aware of this panic-driven sell-off, often choose to divest ahead of the curve to mitigate losses. In the same vein, institutional investors, who are also rational, exploit this fear-induced volatility. By strategically maneuvering the market, they deliberately lower stock prices to secure profitable positions. Consequently, this multifaceted interplay of investor behaviors contributes to a gradual, step-by-step decline in stock prices.

The results show that while media and health experts' social media posts negatively impact the stock market, politicians' posts may have a stabilizing effect. Some key actors and information based on individual-level interactions with investors' stock trading behavior are consistent with our study. For example, the U.S. House of Representatives Speaker indicated that she would pass the subsequent appropriations and outbreak response bill, to which President Trump reversed his previous opposition and endorsed, triggering a more than 9% rise in the DJIA (Pramuk, 2020). However, the Wall Street Journal reported that the turmoil associated with the coronavirus could trigger the bursting of the corporate debt bubble and exacerbate the recession (Lynch, 2020), which led to the DJIA dropping by more than 2,000 points and triggered panic selling. Furthermore, stocks plummeted after the WHO announced the presence of a new variant of the COVID-19 virus (Stein et al., 2021).

Regarding dynamic effects, the results of Hypothesis H3c reveal that the relationship between political agenda attention and stock prices is conditional on public sentiment levels. This implies that the effect of agenda-related

attention on stock prices is influenced by negative biases at the investor's psychological level. Specifically, in times of prevalent negative sentiment, the positive impact of political attention on stock prices becomes more pronounced, encouraging stock-buying behavior and reducing the likelihood of selling. As the sentiment levels become more positive, the effect of politicians' social posts on boosting stock prices weakens. This dynamic suggests that politicians are imparted more to investors with negative sentiment levels than to those with positive sentiment levels. During periods of negative sentiment, investors may interpret increased political attention as a sign of stability or policy clarity, which can be seen as a positive factor amid uncertainty during a crisis. This shows that the government/congress is taking the situation seriously and is likely to implement measures to manage the crisis. This perception can lead investors to feel more confident about the political response, which may in turn influence their investment decisions, potentially leading to an increase in stock prices despite the ongoing pandemic.

Previous scholars (Haroon & Rizvi, 2020) did not investigate how sentiment is transferred step-by-step through the media to the stock market. The results for Hypotheses H2/H4d show the diffusion mechanism of sentiment through a chain of mediation in stock trading behavior. First, negative sentiment triggers media panic, which further triggers increased media hype and, ultimately, negative sentiment leads to stock-selling behavior. Therefore, this study builds on the findings of previous studies to discover the mechanisms and processes of sentiment diffusion. This implies that sentiment on agenda is a diffusion process that affects the stock markets. Sentiments expressed in social media posts can shape the public's expectations of the future. Excessive negative sentiment can trigger psychological anxiety and worries among investors. This process increases uncertainty about the future and reduces investor confidence. Consequently, this process has the potential to lead retail investors to incur losses and may also create opportunities for institutional investors to engage in short selling in the stock market through this agenda sentiment diffusion pathway. Future crisis management efforts may mitigate the adverse effects of a crisis by intervening in the agenda diffusion process.

## Conclusions

This study examined the relationship between various types of opinion leaders' agendas on social media and stock trading behavior during the COVID-19 information pandemic. The results show that increased attention to COVID-19 in the media and public health agendas

triggers stock-selling. By contrast, increased COVID-19 attention to political agendas triggers stock-buying. Furthermore, emotions in public agendas moderate the relationship between attention and stock-trading behavior. Public agenda sentiment triggers stock-selling through a chain-mediated effect. Thus, social media releases by politicians in times of crisis are more effective than media and public health agendas in stopping the stock markets from collapsing.

This study offers insights and guidelines to address the proliferation of infodemic agendas during periods of low sentiment (Zheng et al., 2018). First, it responds to the WHO's call for research on infodemics by examining the impact of the COVID-19 infodemic on the stock market. Second, the proposed agenda-diffusion approach provides a novel theoretical perspective for studying infodemic, extending the theoretical and methodological approaches of traditional communication theory. Finally, the findings of this study offer guidance for early intervention strategies to prevent stock market collapses during similar social media events in the future from a communication science perspective.

This study has some limitations that warrant further investigation. First, this study uses a lexicon approach to analyze tweets. Future research may use more advanced models to conduct sentiment analysis, such as machine learning models, to explore the impact of more detailed sentiments (happy, sad, angry, fearful, etc.) on the stock market. Second, an ARDL model was employed to explore the impact of COVID-19 agenda diffusion on stock trading behavior; future research could benefit from using more advanced time-series analysis models to deepen our understanding of this relationship. Third, enriching quantitative data with qualitative insights through mixed methods research could offer a more comprehensive theoretical perspective on the influence of public agendas on market dynamics, particularly when exploring the role of key actors.

Finally, infodemics, which may not be limited to infectious diseases, can manifest in various forms, with one prominent feature being its diffusion as an agenda. For instance, the collapse of the Silicon Valley Bank within 24 hr (Chowdhury, 2023) illustrates how negative information can influence investors' herd behavior within a single trading day. As more people engage with this agenda, an 'infodemic' forms, which subsequently causes a spillover effect on other institutions following the collapse of one institution. It is essential to understand that no piece of information is innocent during the stock market collapse due to an infodemic. Every snippet of news, no matter how trivial it might seem, can have significant ramifications and contribute to propagation of the infodemic.

## Acknowledgments

Thank you to the reviewers for their valuable comments that have contributed to the improvement of this study.


## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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## Supplemental Material

Supplemental material for this article is available online.

## Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

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