From the cross perspective of communication science and administration management, based on complex network theory, this paper constructs a model of stock price fluctuation risk contagion, which comprehensively considers media sentiment and government supervision strategy, and deeply analyzes the contagion mechanism of stock price fluctuation risk under the interaction of media sentiment and government supervision strategy. The main conclusions are as follows: The stock association network established by random way is more likely to cause contagion of stock price fluctuation risk. Media sentiment tendency, media sentiment intensity, and media attention persistence have positive "U" relationship, inverted "U" relationship, and positive correlation with contagion intensity of stock price fluctuation risk, respectively. There is a negative correlation between the strength, persistence, and timeliness of government supervision and the contagion intensity of stock price fluctuation risk. There is a positive correlation between market noise and contagion intensity of stock price fluctuation risk, and market noise has a restraining effect on media sentiment and government supervision strategy. In addition, the stock price fluctuation risk is inherent risk in the stock market, which cannot be eliminated by adjusting media sentiment and government supervision strategy, but its contagion intensity can be effectively controlled.

1. Introduction

The research of stock price fluctuation has always been the focus of scholars. Strycharz et al. [1] study the role of media reports in explaining stock market fluctuation and find that company topics have a positive Granger effect on stock price fluctuation and that stock price fluctuation prediction can be improved by including emotions and concerns based on media reports. Chen et al. [2] study how the stock information in the financial market can predict the stock price fluctuation and find that the effective use of market information can help to accurately predict the stock price fluctuation. Zheng et al. [3] study the impact of exchange rate on stock price fluctuation and find that although the government intervention strategy of foreign exchange helps to stabilize the exchange rate, it often increases stock price fluctuation. These studies show that not only the information in the financial market has an important predictive value for stock price fluctuation but also the media sentiment and government supervision strategy based on the information have an important impact on stock price fluctuation. At the same time, in view of the randomness and periodicity of the stock market fluctuation and the speculative nature of the investors in the stock market, the stock price is vulnerable to fluctuation due to various uncertain factors [4–6]. However, once the stock price fluctuates abnormally, the stock price fluctuation risk may be induced [7, 8]. At the same time, under the influence of sentiment correlation and policy linkage, the stock price fluctuation risk is easy to spread in a wide range, which will cause serious adverse impact on the stability of the stock market and the whole financial system. In this process, the sentiment conveyed by the media can not only directly affect the behavior choice of investors [9], but also represent the cognitive orientation of the whole stock market. Meanwhile, the government supervision strategy can not only directly adjust the fluctuation of the stock market, but also interact with the media sentiment to affect the stability of the stock market.
market. Therefore, it is of great theoretical and practical significance to deeply analyze the contagion mechanism of media sentiment, government supervision strategy, and their interaction on stock price fluctuation risk.

The stock market is not only a barometer of national economic development, but also the focus of media attention on various events. The media sentiment toward different stock market events reflects the trend of online public opinion and the decision-making choices of investors, which has an important impact on the formation and contagion of stock price fluctuation risk [10, 11]. At present, there are many research works on this aspect, among which the representative ones are as follows: Broadstock and Zhang [12] study the impact of social media sentiment on stock price and find that social media sentiment is closely related to stock price fluctuation and then affects the probability of stock price fluctuation risk. Liang et al. [13] study the ability of media sentiment to predict stock price fluctuation, and find that different media sentiment tendency, media sentiment intensity, and media attention persistence have different effects on predicting stock price volatility. This not only shows that media sentiment has the ability to predict stock price fluctuation, but also shows that different tendency, intensity, and attention persistence of media sentiment are closely related to the stock price volatility risk. More specific research in this field is as follows: Tausch and Zumbuehl [14] study the relationship of news reports with different sentiment tendency and individual risk attitude and find that positive news will enhance investors’ willingness to take risks in the short term, but this will have a negative impact in the long term and affect the stability of stock price in different risk taking processes. Rodríguez and Garza [15] find that the media sentiment intensity plays an important role in the behavior choice of subjects and then affects the stability of the stock market. Barkemeyer et al. [16] study how media attention to scandals changes over time and find that the media attention persistence directly affects the development of events and the contagion of risk. However, these studies not only do not clearly distinguish the impact of media sentiment tendency, media sentiment intensity, and media attention persistence on stock price fluctuation risk, but also do not comprehensively consider the interaction of these factors on stock price fluctuation risk. Therefore, it is necessary to further explore how different media sentiment factors and their interaction affect the contagion of stock price fluctuation risk from the perspective of communication science.

The stock market is also very sensitive to the supervision strategy adopted by the government and thus shows different stock price fluctuation [17–19]. For example, Kuncoro et al. [20] study how different supervision strategy affects the stability of the stock market and find that different government supervision strategy often leads to different stock price fluctuation and then affects the formation of stock price fluctuation risk. Zaremba et al. [21], under the background of COVID-19, investigate the influence of government supervision strategy on stock price fluctuation risk and find that strict government supervision strategy increases the risk of return volatility in international stock market. However, scholars only focus on the impact of government supervision strategy on the whole stock market and do not analyze how government supervision strategy specifically affects the formation and contagion of stock price fluctuation risk. Moreover, according to the existing research, the government supervision strategy includes the government supervision strength [22–24], the government supervision persistence [17, 22], and the government supervision timeliness [24, 25]. At the same time, the influence of these factors of government supervision strategy on stock price fluctuation is heterogeneous. However, scholars also did not distinguish the relationship between these factors of government supervision strategy and stock price fluctuation risk. Therefore, in order to enrich the research of stock price fluctuation risk from the perspective of administration management, it is necessary to analyze the relationship between the factors of different government supervision strategy and their interactions on stock price fluctuation risk in detail.

In addition, in the stock market, media sentiment can not only reflect the implementation of the government supervision strategy, but also affect the sentiment choice of the media. Therefore, the stability of the stock market and the fluctuation of stock price not only are affected by media sentiment and government supervision strategy, but also show more complex evolutionary characteristics under the interaction of the two. However, the current research in this area is still in its infancy, and it needs to explore the contagion evolution characteristics of stock price fluctuation risk under the interaction of media sentiment and government supervision strategy from the cross perspective of communication science and administration management. This helps to determine the contagion intensity of stock price fluctuation risk more accurately and can avoid a series of problems such as low supervision effect caused by underestimated stock price fluctuation risk.

Complex network theory can not only extract the relationship between different agents in complex associated system, but also simplify the influence mechanism under the interaction of different factors. In view of this, complex network theory has become an important tool to explain complex associated systems and their evolutionary characteristics and is widely used in the field of economy and management [26, 27]. As an important part of the national economy, the stock market not only contains complex relationships between different agents, but also presents complex risk evolution characteristics under the interaction of different factors. Therefore, with the help of complex network theory, the stock market can be abstracted as a stock correlation network, and then the risk evolution characteristics can be analyzed under different internal correlations and different factors. At present, there are many research studies on price fluctuation and risk contagion in stock market with the help of complex network theory. The representative research is as follows: Cao et al. [28] combined the complex network method with machine learning to extract the information of related stocks to predict the fluctuation range of stock price and the risk strength. Zhang and Zhuang [4] constructed the network of Chinese stock market and empirically analyzed the relationship between topological characteristics, network stability, and stock price fluctuation based on the complex network theory. These studies provide inspiration and reference for the in-depth analysis of the contagion mechanism of stock price fluctuation risk under the
interaction of media sentiment and government regulatory strategy with the help of complex network theory.

To sum up, from the perspective of communication science and administration management, this study constructs a model of stock price fluctuation risk contagion based on complex network theory and then analyzes the contagion evolution characteristics of stock price fluctuation risk under the influence of media sentiment, government supervision strategy, and their interaction with MATLAB R2014a software. The main contributions of this paper are as follows: (1) Different from the previous single research perspective, this paper explores the contagion mechanism of stock price fluctuation risk from the cross perspective of communication science and administration management, which can more accurately determine the contagion intensity and contagion evolution characteristics of stock price fluctuation risk under the interaction of media sentiment and government supervision strategy. (2) When constructing the network model, this article not only involves the influence of media sentiment and government supervision strategy on the model but also considers the interaction effect of the two on the model at the same time. Therefore, based on this network model, we can more fully and comprehensively analyze the contagion mechanism of stock price fluctuation risk under the influence of media sentiment and government supervision strategy. (3) In this paper, some interesting and practical conclusions are obtained: Firstly, market noise has a restraining effect on media sentiment and government supervision strategy. Secondly, the stock price fluctuation risk is inherent risk in the stock market, which cannot be eliminated by regulating media sentiment and government supervision strategy. Thirdly, the core means is the government supervision strategy to control the stock price fluctuation risk, and at the same time it should properly cooperate with the means of media sentiment and strictly limit the market noise.

The rest of this paper is arranged as follows. Section 2 elaborates the contagion mechanism of stock price fluctuation risk under the interaction of media sentiment and government supervision strategy. Section 3 constructs the model of stock price fluctuation risk contagion based on the comprehensive consideration of media sentiment and government supervision strategy. Section 4 analyzes the contagion evolution characteristics of stock price fluctuation risk under the interaction of media sentiment and government supervision strategy. Section 5 is the conclusion of this research.

2. Contagion Mechanism of Stock Price Fluctuation Risk

The stock price fluctuation risk refers to the risk of abnormal price fluctuation due to the impact of various uncertain factors such as the financial events or financial policies, the guidance of media sentiment, and the influence of government supervision strategy. Before the formation of stock price fluctuation risk and in the contagion process, it is often affected by the interaction between media sentiment and government supervision strategy, which leads to the individual stock price fluctuation risk evolving into the price fluctuation risk of the whole stock market and even the collapse risk of stock price. Its formation and contagion mechanism is shown in Figure 1.

It can be seen from Figure 1 that under the impact of various uncertain factors, the individual stock price may fluctuate abnormally and form the individual stock price fluctuation risk. At the same time, in the stock market, different stocks form stock association network through media sentiment, government supervision strategy, and so on. With the help of the network and the interaction between media sentiment and government supervision strategy, individual stock price fluctuation will lead to abnormal stock price fluctuation in the whole stock market, which will accelerate the contagion of stock price fluctuation risk. In this process, it will further intensify the impact scope and strength of financial events, expand the abnormal fluctuation range of individual stock price, and then induce a new round of rapid contagion of stock price fluctuation risk, which may lead to stock price collapse and turbulence of the whole financial market.

According to the above analysis, media sentiment and government supervision strategy and their interaction can not only affect the formation and contagion of stock price fluctuation risk, but also promote the formation and evolution of stock association network. Therefore, studying the contagion evolution characteristics of stock price fluctuation risk under the influence of media sentiment and government supervision strategy and their interaction is helpful to provide a theoretical basis for government regulatory authorities to formulate targeted measures to prevent abnormal stock price fluctuation.

Under the influence of various uncertain factors, the stock price may fluctuate violently in the stock market, thus forming the stock price fluctuation risk. At the same time, due to the heterogeneity of media sentiment and government supervision strategy, it may have an important impact on the formation and contagion of stock price fluctuation risk. Therefore, in this process, stocks show the following three types of state:

(1) Susceptible stocks (SS). This kind of stocks refers to the stock that has no abnormal price fluctuation for the time being but is easily affected by the infectious stocks with abnormal price fluctuation under the influence of various media emotions and government supervision strategies.

(2) Infectious stocks (IS). This kind of stocks refers to the stock that reacts excessively to various uncertain factors and has already experienced abnormal stock price fluctuation, which may infect the stock price fluctuation risk.

(3) Recovered stocks (RS). This kind of stocks refers to the stock that has a high cognitive and judgment ability with respect to the impact of various uncertain factors, media emotion, and government supervision...
strategy, so as to avoid the impact of various uncertain factors or the stock price fluctuation risk.

In this paper, SS, IS, RS are used to represent the number of three types of stocks in the stock market, respectively. The transition rules among the three types of stocks are shown as follows (Figure 2).

First of all, under the influence of various uncertain factors, it is assumed that when the media sentiment is more extreme and the media sentiment intensity and media attention persistence are high, the stock price fluctuation risk will be transmitted to the related susceptible stocks with $\lambda$ ($0 \leq \lambda \leq 1$) probability. Moreover, when the strength, persistence, and timeliness of government supervision are poor, the stock price fluctuation risk will be transmitted to the susceptible stocks with $\eta$ ($0 \leq \eta \leq 1$) probability. At the same time, under the interaction of media sentiment and government supervision strategy, the stock price fluctuation risk will be transmitted to the related susceptible stocks with $\lambda \eta$ probability.

Secondly, under the influence of neutral media sentiment, moderate media sentiment intensity, and media attention persistence, as well as higher strength, persistence, and timeliness of government supervision, on the one hand, some susceptible stocks are free from the impact of stock price fluctuation risk and directly change into recovered stocks with $\rho$ ($0 \leq \rho \leq 1$) probability. On the other hand, some infectious stocks get rid of the stock price fluctuation risk and turn into recovered stocks with $\theta$ ($0 \leq \theta \leq 1$) probability.
It needs to be noted that, in view of the robustness of recovered stocks and under the condition of reasonable regulation of media sentiment and government regulation, since recovered stocks can be promoted to form, the probability of recovered stocks converting into other stocks will be very small. Therefore, in this paper, we do not consider the state transition of immune stocks.

Finally, it is assumed that, in each period of time, new stocks enter the stock market with ε (0 ≤ ε ≤ 1) probability and exit some stocks with τ (0 ≤ τ ≤ 1) probability.

3. Model of Stock Price Fluctuation Risk Contagion Based on Stock Association Network

3.1. Stock Association Network. In the stock market, with the help of the linkage of various government supervision policies and the relevance of various media sentiments, the stock association network is formed. In this network, nodes represent stocks and edges represent the relationship between stocks due to policy linkage and sentiment relevance. In order to better show the formation process of stock association network, this paper describes the formation algorithm as follows:

1. α₀ infectious stocks and m₀ interstock association relationships (α₀ > 0, m₀ > 0) exist at T₀.
2. At each period Tᵢ (i = 1, 2, 3, . . .), α susceptible stocks are added to stock association network, and every new stocks have β edges (α > 0, β > 0).
3. The new susceptible stocks connect the existing infectious stocks randomly in the proportion of δ or connect the existing infectious stocks preferentially in the proportion of (1 − δ) (0 ≤ δ ≤ 1).

(4) The probability that any existing stock i is selected in random linking is 1/α₀ + αT, and the probability that any existing stock i is selected in preferential linking is Πᵢ (0 ≤ Πᵢ ≤ 1):

$$\Pi_i = \frac{k_i}{\sum_j k_j},$$

where kᵢ represents the degree of the existing stock i.

The above algorithm shows that the change rate of degree kᵢ of stock i can be expressed as follows:

$$\frac{\partial k_i}{\partial T} = \frac{-\alpha \beta \delta}{\alpha_T + \alpha T} + (1 - \delta) \alpha \beta \Pi_i = \frac{-\alpha \beta \delta}{\alpha_T + \alpha T} + (1 - \delta) \alpha \beta \frac{k_i}{\sum_j k_j}.$$  \hspace{1cm} (2)

Given that Σj kⱼ = 2(αβT + m₀), (2) can be translated into the following:

$$\frac{\partial k_i}{\partial T} = \frac{-\alpha \beta \delta}{\alpha_T + \alpha T} + (1 - \delta) \alpha \beta \frac{k_i}{2(\alpha \beta T + m_0)}.$$  \hspace{1cm} (3)

When T → ∞, αT + α₀ = αT and αβT + m₀ = αβT. In addition, the initial condition can obtain kᵢ(Tᵢ) = αβ; therefore, the solution of (3) is

$$k_i = \left(\alpha \beta + \frac{\beta \delta}{1 - \delta}\right) \left(\frac{T}{T_i}\right)^{(1-\delta)/2} - \frac{2 \beta \delta}{1 - \delta}.$$  \hspace{1cm} (4)

When new stocks enter stock association network at every similar period, the probability density of the selected stock i at time T is

$$P_i = \frac{1}{\alpha T + \alpha_0}.$$  \hspace{1cm} (5)

When kᵢ < k, P(kᵢ(T) < k) is

$$P(k_i(T) < k) = 1 - \frac{T}{\alpha_0 + \alpha T} \left[\frac{k(1 - \delta) + 2 \beta \delta}{\alpha \beta(1 - \delta) + 2 \beta \delta}\right]^{-(2/1 - \delta)}.$$  \hspace{1cm} (6)

Based on (8), the degree distribution function of stock association network is

$$P(k) = \frac{\partial P(k_i(T) < k)}{\partial k} = \frac{2}{\alpha[\alpha \beta(1 - \delta) + 2 \beta \delta]} \left[\frac{k(1 - \delta) + 2 \beta \delta}{\alpha \beta(1 - \delta) + 2 \beta \delta}\right]^{\delta - 3/1 - \delta}.$$  \hspace{1cm} (9)
3.2. Model of Stock Price Fluctuation Risk Contagion. In order to analyze the contagion evolution characteristics of stock price fluctuation risk under the influence of media sentiment, government supervision strategy, and their interaction, it is necessary to construct a model of stock price fluctuation risk contagion. In this study, the stock market is abstracted as a stock association network, and $N$ is assumed to be the total number of stocks in the network. $ss$, $is$, $rs$ account for the proportion of the susceptible stocks, the infectious stocks, and the recovered stocks, respectively, namely $ss = SS/N$, $is = IS/N$, $rs = RS/N$, and $ss + is + rs = 1$ ($0 \leq ss$, $is$, $rs \leq 1$). Moreover, it is assumed that the density of the infectious stocks whose degree is $k$ is $is_k(T)$, and the connected probability of the susceptible stocks and the infectious stocks is $\Theta(T)$ at $T$ time. Moreover, since media sentiment and government supervision strategy and their interaction exert important disturbing effect on the contagion of stock price fluctuation risk, the influencing factors of media sentiment and government supervision strategy should be taken into account in the construction of model of stock price fluctuation risk contagion. The influencing factors of media emotion mainly include the following:

(1) Media sentiment tendency $\gamma$ [10, 11, 14, 29, 30], which reflects the sentiment tendency of the media when reporting the stock market, can be divided into three categories: the positive sentiment tendency means that the media tends to report too much positive stock market news, the objective sentiment means that the media reports the stock market news truthfully, and the negative sentiment tendency means that the media tends to report too much negative stock market news. The more $\gamma$ tends to 0, the more negative the media sentiment is, $\gamma = 0$ means objective media sentiment, and the more $\gamma$ is inclined to 1, the more optimistic the media sentiment is.

(2) Media sentiment intensity $\omega$ [15, 31, 32] reflects the media’s emphasis on relevant stock market events. The greater the media sentiment intensity $\omega$ is, the more the emphasis the media attaches to relevant stock market events is, the higher the frequency of reporting is at the same time, and the wider the coverage of reports is.

(3) Media attention persistence $\psi$ [11, 16, 33, 34] reflects the persistence of media attention to relevant stock market events. The higher the media attention persistence $\psi$, the stronger the continuity of media attention to relevant stock market events, and the more comprehensive and in-depth display of the whole picture of the event.

Based on the above influencing factors of media sentiment, this paper defines the contagion probability $\lambda$ of stock price fluctuation risk caused by media sentiment as follows:

$$\lambda = \frac{1}{10}\psi\left(\gamma^2 - \gamma + \frac{1}{2}\right)(-\omega^2 + \omega + \frac{1}{4}).$$

(10)

In addition, the influencing factors of government supervision strategy mainly include the following aspects:

(1) Government supervision strength $\xi$ [19, 22–24] reflects the government’s attention to relevant stock market events and the intensity of supervision. The stronger the government supervision strength $\xi$ is, the more the attention the government attaches to the relevant stock market events is, and the higher the intensity of the supervision measures is.

(2) Government supervision persistence $\kappa$ [17, 19, 22] reflects the persistence of government supervision of stock market events. The higher the government supervision persistence $\kappa$ is, the stronger the continuity of government supervision of related stock market events.

(3) Government supervision timeliness $\mu$ [19, 24, 25] reflects the timeliness of government supervision of stock market events. The greater the government supervision timeliness $\mu$ is, the more timely the government supervision of relevant stock market events.

Based on the above influencing factors of government supervision strategy, this study defines the contagion probability $\eta$ of stock price fluctuation risk caused by government supervision strategy as follows:

$$\eta = \frac{1}{10}\xi^{-\frac{1}{10}}(1 - e^{-1/\xi})(1 - e^{-1/\mu}).$$

(11)

Finally, given that market noise $\phi$ plays an important role in media sentiment and the interaction between media sentiment and government supervision strategy affects the contagion intensity of stock price fluctuation risk, then the comprehensive infectious rate $\varphi$ of stock price fluctuation risk can be expressed as follows:

$$\varphi = \phi(\lambda + \eta + \lambda\eta)$$

$$= \frac{1}{10}\phi\left[\frac{1}{10}\psi\left(\gamma^2 - \gamma + \frac{1}{2}\right)(-\omega^2 + \omega + \frac{1}{4}) + 1\right]\xi^{-\frac{1}{10}}(1 - e^{-1/\xi})(1 - e^{-1/\mu}) + \psi\left(\gamma^2 - \gamma + \frac{1}{2}\right)(-\omega^2 + \omega + \frac{1}{4}).$$

(12)

According to the contagion rules of stock price fluctuation risk and the mean-field theory [11, 27], this paper presents the differential equations of the model of stock price fluctuation risk contagion under the influence of media sentiment, government supervision strategy, and their interaction:
\[
\frac{ds_k(T)}{dT} = \varepsilon - k\varphi ss_k(T)\Theta(T) - \rho ss_k(T),
\]
\[
\frac{ds_k(T)}{dT} = k\varphi ss_k(T)\Theta(T) - \varepsilon \Theta(T),
\]
\[
\frac{ds_k(T)}{dT} = \Theta(T)(\frac{1}{\Theta_k} - s_k(T)) - \Theta(T). (13)
\]

According to (13), for the steady-state condition \(\frac{ds_k(T)}{dT} = 0\), the steady-state value becomes \(s_k(T)\):
\[
s_k(T) = \frac{k\varphi ss_k(T)\Theta(T)}{\varepsilon} = \frac{k\varphi \Theta(T)}{\rho \Theta(T) + k\varphi \Theta(T)} (14)
\]

The average density of the infectious stocks becomes \(\sum_k P(k)s_k(T)\). Based on (14), \(\Theta(t)\) becomes
\[
\Theta(T) = T \sum_k \frac{kP(k)is_k(T)}{\sum_s P(s)} = T \sum_k \frac{kP(k)is_k(T)}{\sum_s P(s)} = 1 \sum_k kP(k)i(T), (15)
\]
where \(\langle k \rangle\) represents the average degree of stock association network.

\[
R_0 = \frac{\varepsilon \sum_k kP(k)\varphi}{\rho \Theta} = \frac{\varepsilon \sum kP(k)\varphi}{\rho \Theta} = \frac{\varepsilon \sum kP(k)\varphi}{\rho \Theta}.
\]

\[
\sum_k \frac{kP(k)\varphi}{\rho \Theta} = \frac{\varepsilon \sum kP(k)\varphi}{\rho \Theta}.
\]

\[
\sum_k \frac{kP(k)\varphi}{\rho \Theta} = \frac{\varepsilon \sum kP(k)\varphi}{\rho \Theta}.
\]

Given that \(\langle k \rangle = \sum_k kP(k)\) and \(\langle k^2 \rangle = \sum_k k^2P(k)\), (14) and (15) can be combined as follows:
\[
\Theta(T) = \frac{1}{\langle k \rangle} \sum_k kP(k) \frac{k\varphi \Theta(T)}{\rho \Theta + k\varphi \Theta(T)}. (16)
\]

Given that \(\Theta = \Theta(T)\), (16) has a trivial solution: \(\Theta = 0\). If (16) has a nontrivial solution, \(\Theta \neq 0\), then the necessary condition becomes
\[
\frac{d}{d\Theta} \left( \frac{1}{\langle k \rangle} \sum_k kP(k) \frac{k\varphi \Theta(T)}{\rho \Theta + k\varphi \Theta(T)} \right) \bigg|_{\Theta=0} \geq 1, (17)
\]

so
\[
\frac{1}{\langle k \rangle} \sum_k kP(k) \frac{k\varphi \Theta(T)}{\rho \Theta} \geq 1. (18)
\]

Therefore, this paper can get the contagion threshold \(R_0\) of stock price fluctuation risk under the interaction of media sentiment and government supervision strategy:

\[
R_0 = \frac{\varepsilon \sum k^2P(k)\varphi}{\rho \Theta} = \frac{\varepsilon \sum k^2P(k)\varphi}{\rho \Theta}.
\]

When \(R_0 < 1\), the stock price fluctuation risk does not spread and gradually dies out. When \(R_0 = 1\), it is the contagion threshold of stock price fluctuation risk. When \(R_0 > 1\), the stock price fluctuation risk is easy to infect in the stock association network, and the greater \(R_0\) is, the more stocks are infected.
4. Simulation Analysis

In view of the fact that it is difficult to obtain the actual data of media sentiment and government supervision strategy, this paper mainly uses the simulation method to realize the theoretical analysis of the contagion mechanism, rather than the empirical research method. Numerical simulation analysis is the most effective way for testing without a large number of empirical validations of real-time dynamic data [27]. Therefore, based on the above-mentioned model of stock price fluctuation risk contagion, this section uses MATLAB R2014a software to simulate and analyze the contagion evolution characteristics of stock price fluctuation risk under the interaction of media sentiment and government supervision strategy. The benchmark values of simulation parameters are shown in Table 1.

4.1. Stock Association Network Structure and Stock Price Fluctuation Risk Contagion. Figure 3 shows the influence of stock price fluctuation risk contagion on different stock association network structures. From Figure 3, it can be seen that the contagion intensity of stock price fluctuation risk is increasing with the increase of random connection probability. This indicates that the stock association network established by random way is more prone to contagion of stock price fluctuation risk. As can be seen from Figures 3(a)–3(c), when the structure of the stock association network is determined, the contagion intensity of stock price fluctuation risk caused by changing the tendency, intensity, and persistence of media sentiment has been at a high level, but its relationship with the contagion intensity of stock price fluctuation risk is still unclear. Moreover, as can be seen from Figure 3(d), there is a positive correlation between the market noise and the contagion intensity of stock price fluctuation risk. At the same time, as can be seen from Figures 3(e)–3(g), there is a negative correlation between the intensity, persistence, and timeliness of government supervision and the contagion intensity of stock price fluctuation risk. This paper will further explore the impact of media sentiment, government supervision strategy, and their interaction on the contagion intensity of stock price fluctuation risk.

4.2. Media Sentiment and Stock Price Fluctuation Risk Contagion. Figure 4 shows the influence of different media sentiment factors on the contagion intensity of stock price fluctuation risk. From Figure 4(a), it can be seen that media sentiment tendency and media sentiment intensity have positive and inverted "U" relationships with the contagion intensity of stock price fluctuation risk, respectively. The contagion intensity of stock price fluctuation risk first declines and then rises with media sentiment tendency and media sentiment intensity increase simultaneously. As can be seen from Figures 4(b) and 4(c), there is a significant positive correlation between media attention persistence and contagion intensity of stock price fluctuation risk. The contagion intensity of stock price fluctuation risk first declines and then rises with media sentiment tendency and media attention persistence increase simultaneously. The contagion intensity of stock price fluctuation risk first rises and then declines with media sentiment intensity and media attention persistence increase simultaneously. In addition, the media attention persistence has a strengthening effect on media sentiment tendency and media sentiment intensity and then aggravates the contagion of stock price fluctuation risk under the interaction of each other.

The specific analysis shows the following: First of all, relatively objective media sentiment tendency and moderate media sentiment intensity can reduce the contagion intensity of stock price fluctuation risk. Secondly, the media attention persistence to the stock market can alleviate the problem of information asymmetry, but it is easy to form emotional resonance with investors, which leads to the rapid spread of stock price fluctuation risk under the herd effect. Finally, different media sentiment factors and their interaction are the important public opinion factors that induce the contagion of stock price fluctuation risk, and, by regulating the relevant factors of media sentiment, we can only alleviate the contagion of stock price fluctuation risk to a certain extent but cannot achieve the purpose of gradual extinction of contagion of stock price fluctuation risk. This has implications for government regulators as follows: although controlling public opinion to regulate media sentiment is an important means to control risk in the stock market, media sentiment has limited effect on controlling the contagion of stock price fluctuation risk, and it should be realized in coordination with other supervision tools.

4.3. Government Supervision Strategy and Stock Price Fluctuation Risk Contagion. Figure 5 shows the influence of government supervision strategy factors on the contagion intensity of stock price fluctuation risk. It can be seen from Figures 5(a) and 5(b) that with the synchronous increase of government supervision strength, government supervision persistence, and government supervision timeliness, the contagion intensity of stock price fluctuation risk presents a significant monotonic decreasing trend as government supervision strength increases simultaneously with government supervision persistence and government supervision timeliness. Similarly, it can be seen from Figure 5(c) that, with the synchronous increase of government supervision persistence and government supervision timeliness, although there is a monotonic decreasing trend, it is not significant.

The specific analysis shows the following: First, it further verifies that there is a significant negative correlation between the strength and timeliness of government supervision and the contagion intensity of stock price fluctuation risk. Moreover, when the strength and timeliness of government supervision is high enough, it can effectively inhibit the contagion of stock price fluctuation risk. Second, although there is a negative correlation between the persistence of government supervision and the contagion intensity of stock price fluctuation risk, the negative correlation is not significant when the government supervision persistence is small. At the same time, in view of the
high contagion intensity of stock price fluctuation risk caused by the government supervision persistence, it shows that the government supervision persistence is the core factor inducing the contagion of stock price fluctuation risk and can weaken the strength and timeliness of government supervision. Third, different government supervision strategy factors and their interaction are the important government factors that induce the contagion of stock price fluctuation risk. Moreover, the contagion of stock price fluctuation risk can be effectively alleviated by adjusting the relevant factors of government supervision strategy, but it cannot achieve the purpose of gradual extinction of contagion of stock price fluctuation risk. Following is enlightenment to government regulators: Government supervision has always been the core means to maintain the stability of stock price and control the stock price fluctuation risk. Moreover, in order to ensure the effectiveness of the supervision strategy, the government regulatory authorities should maintain a high degree of supervision persistence and constantly improve the intensity and timeliness of supervision.

4.4. The Interaction between Media Sentiment and Government Supervision Strategy and Stock Price Fluctuation Risk Contagion. It can be seen from Figures 4 and 5 that regulating single factor of media sentiment and government supervision strategy cannot achieve the goal of gradual extinction of stock price fluctuation risk contagion. This section further explores whether comprehensively regulating the factors of media sentiment and government supervision strategy can achieve this goal, and the results are shown in Figure 6. It can be seen from Figures 6(a), 6(e), 6(i), 6(n), and 6(o) that when market noise increases synchronously with media sentiment tendency, media sentiment intensity, media attention persistence, government supervision persistence, and government supervision timeliness, respectively, the contagion intensity of stock price fluctuation risk presents a monotonous upward trend. It can be seen from Figures 6(b), 6(f), 6(j), and 6(m) that when government supervision strategy increases synchronously with media sentiment tendency, media sentiment intensity, and media attention persistence, the contagion intensity of stock price fluctuation risk presents a monotonous decreasing trend. Meanwhile, it can be seen from Figures 6(c), 6(g), and 6(k) that when government supervision persistence increases synchronously with media sentiment tendency, media sentiment intensity, and media attention persistence, the contagion intensity of stock price fluctuation risk presents a monotonous decreasing trend. Similarly, it can be seen from Figures 6(d), 6(h), and 6(l) that when government supervision timeliness increases synchronously with media sentiment tendency, media sentiment intensity, and media attention persistence, the contagion intensity of stock price fluctuation risk presents a monotonous decreasing trend.

The specific analysis shows the following: First of all, it further verifies that there is a positive correlation between the market noise and the contagion intensity of stock price fluctuation risk. Meanwhile, market noise can not only cause a wider range of stock price fluctuation risk contagion, but also inhibit media sentiment and government supervision strategy. This shows that various uncertain factors are often closely related to market noise in the stock market. Moreover, market noise will affect the actual effect of media sentiment and government supervision strategy. Secondly, through the comprehensive regulation of media sentiment,
Figure 3: The impact of stock association network structure on the contagion intensity of stock price fluctuation risk.

Figure 4: The impact of media sentiment on the contagion intensity of stock price fluctuation risk.
Figure 5: The impact of government supervision strategy on the contagion intensity of stock price fluctuation risk.

Figure 6: The impact of the interaction between media sentiment and government supervision strategy on the contagion intensity of stock price fluctuation risk.
Figure 7: Continued.
Figure 7: Continued.
government supervision strategy, and market noise, we cannot achieve the goal of gradual extinction of stock price fluctuation risk contagion, but we can control the intensity of stock price fluctuation risk contagion in a small range. In particular, the control effect is more obvious when it is adjusted by market noise or government supervision strength. This shows that the stock price fluctuation risk is inherent risk in the stock market, which cannot be eradicated and can only be strictly controlled through various means. Finally, compared with the media sentiment factors, the influence of government supervision strategy on the contagion intensity of stock price fluctuation risk is more significant. This also further proves that the core means to maintain the stability of the stock market is still an effective government supervision strategy, and at the same time it should cooperate with the means to regulate media sentiment and strictly limit the disturbing effect of market noise.

4.5. Robustness Test. By changing the key factors of media sentiment and government supervision strategy, we can further test the evolution trend of contagion intensity of stock price fluctuation risk. This section explores the robustness of media sentiment and government supervision strategy on the contagion intensity of stock price fluctuation risk. The results are shown in Figure 7. The specific analysis can find the following: Under the combination of different media sentiment and government supervision strategy, the evolution trend of contagion intensity of stock price fluctuation risk is basically consistent. This shows that the conclusion of the simulation has strong robustness. In addition, the results from Figure 7 can effectively support the research conclusions in Figures 3–6 and further emphasize the robustness of the model and simulation results in this paper.

5. Conclusion

Once the stock price fluctuation risk spreads widely, it will cause serious adverse impact on the stability of the stock market. Based on the comprehensive consideration of the influence of media sentiment and government supervision strategy on the of stock price fluctuation risk contagion, this paper constructs a model of stock price fluctuation risk contagion using the complex network theory and then discusses the contagion evolution characteristics of the stock price fluctuation risk under the interaction of media sentiment and government supervision strategy. The main conclusions are as follows:

1. The stock association network established by random way is more likely to infect the stock price fluctuation risk. When the structure of the stock association network is certain, the media sentiment tendency and the media sentiment intensity show a positive and inverted “U” relationship with the contagion intensity of stock price fluctuation risk, respectively. At the same time, media attention persistence has a significant positive correlation with the contagion intensity of stock price fluctuation risk and has a strengthening effect on media sentiment tendency and media sentiment intensity. In addition, the strength, persistence, and timeliness of
government supervision are negatively correlated with the contagion intensity of stock price fluctuation risk.

(2) There is a positive correlation between market noise and contagion intensity of stock price fluctuation risk. Market noise can inhibit media sentiment and government regulatory strategy. In addition, the stock price fluctuation risk is inherent risk in the stock market. Whether through single adjustment or comprehensive adjustment of media sentiment and government supervision strategy, the purpose of gradual extinction of stock price fluctuation risk contagion cannot be achieved, but the contagion intensity of stock price fluctuation risk can be reduced. In particular, the control effect is more obvious when the market noise or the government supervision intensity is used for comprehensive regulation.

In this paper, the influence mechanism of media sentiment and government supervision strategy and their interaction on the contagion of stock price fluctuation risk are deeply explored, which is helpful for government regulators to continuously optimize the supervision strategy for the stock market and provides theoretical reference for improving the supervision efficiency. However, this study finds that investors also play an important role in the contagion of stock price fluctuation risk. Therefore, it is necessary to continue to add the perspective of behavioral finance on the basis of this research and further comprehensively consider the interaction between investors, media, and government, so as to analyze the contagion mechanism of the stock price fluctuation risk in a more detailed way. This will be the direction and focus of the follow-up study.

Data Availability
This paper uses simulation analysis; no data are provided.

Conflicts of Interest
The author declares no conflicts of interest.

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