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Does biodiversity attention affect risk spillover in the AFHF sectors?—Evidence from Chinese stock markets

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ABSTRACT

This study constructs a China Biodiversity Attention Index (BAI) and examines its impact on the spillover effects among agriculture, forestry, animal husbandry, and fishery (AFHF) sectors. Using the quantile connectivity approach, we estimate cross-sector risk spillovers among these sectors. The findings reveal that increased attention to biodiversity following the release of the Kunming Declaration reduces the total spillover effects among these sectors. Furthermore, employing the GARCH-MIDAS model, we demonstrate that attention to biodiversity mitigates the total spillover of the AFHF sectors during extreme upward movements; however, its impact on the risk spillover of the four specific sectors varies.

1. Introduction

In recent years, public attention to biodiversity conservation has shifted toward the implementation of specific action plans by all relevant stakeholders (Sommerer and Lim, 2016). The issuance of global initiatives such as the Kunming Declaration has gradually heightened awareness of biodiversity protection and related issues. As the public focus on biodiversity-related events continues to grow, it can influence the decision making and investment portfolios of relevant investors, impact financial markets in industries heavily reliant on natural resources (Kalhoro and Kyaw, 2024), and even drive regulatory changes aimed at biodiversity conservation (El Ouadghiri et al., 2025).

In China, the agriculture, forestry, animal husbandry and fishery (AFHF) sectors are highly dependent on biodiversity (Ma et al., 2024). These sectors rely on ecosystems for pollination, climate stability, and soil and water conservation (Zhou et al., 2025a). Empirical research indicates that China's AFHF face significant exposure to biodiversity risks (He et al., 2024), and companies in these sectors are particularly sensitive to biodiversity-related issues (Liang et al., 2024). Biodiversity risks have been shown to negatively predict the performance of the stock market in the AFHF sectors (Ma et al., 2024). Increased public attention to biodiversity may alter investor sentiment, affecting corporate decision making and performance in the AFHF sectors, and potentially increasing the risk of stock market crashes (Liang et al., 2024). In contrast, companies with robust biodiversity management practices tend to have a lower risk of a stock market crash (Bassen et al., 2024).

Emerging literature has begun to explore the impact of biodiversity risks and public attention on investors and stock markets (El Ouadghiri et al., 2025; Zhou et al., 2025a; Du et al., 2025). Behavioral finance theory suggests that public attention to biodiversity can shape investor behavior, thereby influencing stock market dynamics (Tetlock, 2007; Broadstock and Zhang, 2019). Increased attention to biodiversity may lead investors to favor stocks that are beneficial to nature, while increased biodiversity

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risks can exacerbate investor concerns, leading to higher returns for stocks less correlated with biodiversity loss (Ma et al., 2024). Moreover, enterprises are likely to encounter financing difficulties and consequently reduce their dividend payments (Zhou et al., 2025b). This dynamic can also increase the spillover effects between socially responsible investments and commodity markets (Kalhoro and Ahmed, 2025). Notably, following the United Nations Biodiversity Conference (COP15), the biodiversity risk index surged, and the return rate of the biodiversity stock index increased significantly (El Ouadghiri et al., 2025), suggesting that investors may now demand risk premiums due to uncertainties in U.S. stock market regulations related to biodiversity protection (Garel et al., 2024). However, most existing research has focused on stock market returns (Ma et al., 2024; Liang et al., 2024), neglecting the impact of public attention to biodiversity on the risk contagion of industries heavily dependent on natural resources. As a major agricultural country, China must ensure the healthy development of the AFHF sectors and prevent systemic risks. Therefore, it is crucial to understand whether and how public attention to biodiversity affects the transmission of financial market risk in the AFHF sectors.

In this context, our incremental academic contributions are as follows. First, compared to the Baidu search engine (Zhou et al., 2025a), we construct China's BAI using the news media, which prioritizes precision and offers investors more reliable insights (Jeon et al., 2022; Jiang et al., 2024). Second, recognizing the significance of the Kunming Declaration, we employ the QVAR model to comprehensively compare the total spillover of the AFHF sectors before and after this time node. Finally, we empirically examine how public attention to biodiversity impacts spillover effects in AFHF sectors, incorporating key factors for sectors highly dependent on biodiversity. This is crucial as current research mainly focuses on the link between biodiversity risk and corporate governance (Yang and Li, 2025; Pi et al., 2025; Tian and Chen, 2025a).

The remainder of this paper is structured as follows. Section 2 describes the research methodology, Section 3 presents the data and BAI, Section 4 presents the empirical results, and Section 5 concludes the study.

2. Methodology

2.1. Quantile Vector Autoregression (QVAR)

While previous studies have relied on conditional mean models (Ma et al., 2025), our research employs quantile models to capture nuanced risk dynamics across the AFHF sectors, deepening understanding of extreme spillover risks. Following Ando et al. (2022), we quantify the cross-sector risk spillover effect of the AFHF sectors at different quantiles. First, we estimate an n-dimensional p-order Vector Autoregression model (QVAR), namely:

$$y_t = \mu(\tau) + \sum_{s=0}^{\infty} A_s(\tau) e_{t-s}(\tau),\ t = 1, 2, 3, \dots, T \tag{1}$$

where $\mu(T) = \left(I_n - B_1(\tau) - \cdots - B_p(T)\right)^{-1} C(\tau), A_S(\tau)$ is an $\mathrm{n} \times \mathrm{n}$ matrix, satisfying the following formula:

$$A_S(\tau) = \begin{cases} 0, & s < 0 \\ I_n, & s = 0 \\ B_1(\tau)A_{s-1}(\tau) + \cdots + B_P(\tau)A_{s-p}(\tau), & s > 0 \end{cases} \tag{2}$$

To predict errors and derive spillover index results, we introduce the Generalized Forecast Error Variance Decomposition model (GFEVD), as shown below:

$$\theta_{ij}^g(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (e_i' h_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} (e_i' h_h \Sigma e_i)} \tag{3}$$

where $\theta_{ij}^g(H)$ is the contribution of the jth variable to the variance of the pre- diction error of the ith variable in the H prediction horizon, $\sum$ is the variance matrix of the error vector, σ_{jj}^{-1} is the jth diagonal element of the matrix $\sum$, e_i is a unit vector. The value of ith is 1 and the remaining values are 0. Then Eq. (3) can be normalized as:

$$\tilde{\theta}_{ij}^g(H) = \frac{\theta_{ij}^g(H)}{\sum_{j=1}^N \theta_{ij}^g(H)} \tag{4}$$

We can obtain the total connectivity index (TCI) at the quantile τ, namely:

$$TCI(\tau) = \frac{\sum_{i=1}^N \sum_{j=1, i\neq j}^N \widetilde{\theta}_{ij}^g(H)}{N} \times 100 \tag{5}$$

The spillover indices from market i and to market i are constructed respectively as follows:

$$FROM_i(\tau) = \sum_{j=1, i\neq j}^N \widetilde{\theta}_{ij}^g(H) \tag{6}$$

$$TO_i(\tau) = \sum_{j=1, i\neq j}^N \widetilde{\theta}_{ji}^g(H) \tag{7}$$

Finally, we define the net spillover index of variable i at the quantile τ as:

$$NET_i(\tau) = TO_i(\tau) - FROM_i(\tau) \tag{8}$$

Table 1
Statistic description of the returns.

	Agriculture	Forestry	Animal husbandry	Fishery
Mean	0	0	0.001	0
Median	0.001	0	0	0
Max	0.095	0.092	0.318	0.109
Min	−0.105	−0.102	−0.105	−0.105
Std.Dev	0.022	0.025	0.023	0.023
Skewness	−0.459	−0.360	0.829	−0.487
Kurtosis	3.699	2.969	16.387	4.097
ADF	−17.389***	−11.276***	−12.975***	−10.617***

Notes: The asterisk *** denotes the rejection of unit root at the 1% significance level.

2.2. GARCH-MIDAS

Based on the QVAR method, the TCI of China's AFHF stock indices is calculated daily, while the BAI is calculated monthly. Therefore, this paper adopts the mixed-frequency GARCH-MIDAS model (Engle et al., 2013), as follows:

$$r_{i,t} = \mu + \sqrt{\tau_t g_{i,t}}\varepsilon_{i,t} \ \forall i = 1, 2, \dots, N_t \tag{9}$$

where $r_{i,t}$ represents the daily return rate of AFHF spillover index on day i of month t, N_t represents the number of days in month t, τ_t means the long-term component of the volatility of AFHF spillover index, and $g_{i,t}$ represents the short-term component. For the short-term component $g_{i,t}$, the standard GARCH$(1, 1)$ process can be used to characterize:

$$g_{i,t} = (1 - \alpha - \beta) + \alpha \frac{(r_{i-1,t} - \mu)^2}{\tau_t} + \beta g_{i-1,t} \tag{10}$$

where $\alpha > 0,\ \beta > 0,\ \alpha + \beta < 1$.

Referring to the MIDAS regression method proposed by Ghysels et al. (2005), based on the realized volatility, the long-term component τ_t is described, and it is replaced with the BAI in this paper, as follows:

$$\log_{\tau_t} = m_c + \theta \sum_{k=1}^{K_c} \varphi_k(\omega_1, \omega_2) BAI_{t-k} \tag{11}$$

where m is a constant term, θ is the impact coefficient of RV_t on the long-term volatility τ_t, K_c represents the maximum number of lagged realized volatilities, and $\varphi_k(\omega_1, \omega_2)$ represents the structural weight based on the Beta function equation, namely:

$$\varphi_k(\omega_1, \omega_2) = \frac{(k/K_c)^{\omega_1 - 1}(1 - k/K_c)^{\omega_2 - 1}}{\sum_{j=1}^{K_c}(j/K_c)^{\omega_1 - 1}(1 - j/K_c)^{\omega_2 - 1}} \tag{12}$$

to ensure that the weights of lagged items are attenuated (i.e., the smaller the lagged period, the greater the impact on the current period) and the model is concise, this paper sets the constraint weighting condition $\omega_1 = 1$ for the weight equation, only the parameter ω_2 determines the decay rate of the low-frequency variable to the long-term component.

3. Data and biodiversity attention index

We obtain the stock indices of the agriculture, forestry, animal husbandry, and fishery sectors issued by the China Securities Regulatory Commission. The data comes from the Wind database, covering the period from July 2, 2013, to June 28, 2024, with a total of 2675 trading days. The return (r_t) is calculated as:

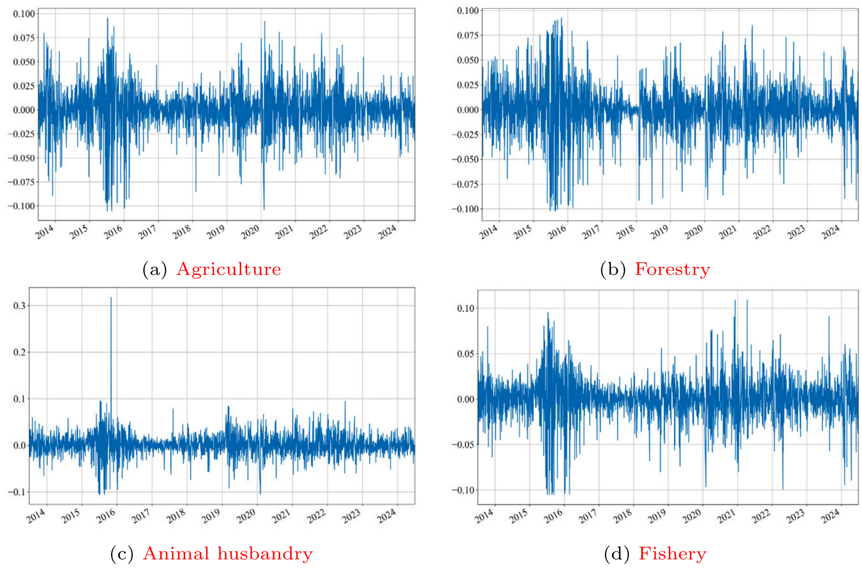
$$r_t = \ln(p_t/p_{t-1}) \times 100 \tag{13}$$

where p_t represents the closing price at time t.

Table 1 provides an overview of descriptive statistics. The ADF tests suggest that all return sequences are stationary. In addition, Fig. 1 demonstrates the dynamic changes in the return of four sectors from July 2, 2013 to June 28, 2024.

In this study, China's BAI is developed by analyzing news reports from three prominent Chinese newspapers: People's Daily, Economic Daily, and China Environment News, spanning from July 2013 to June 2024. The construction of the BAI involves several methodical steps. Initially, we extract, clean, and preprocess textual data from the online news archives of these newspapers. Subsequently, we establish a specialized keyword dictionary to identify and filter relevant biodiversity-related content, which is then subjected to manual verification. Following this, we calculate the monthly conditional publication frequencies for each newspaper, standardize these frequencies, and calculate their arithmetic mean. This mean is normalized to a baseline of 100 to derive the final values of the monthly index.

As shown in Table 2, we formulate the comprehensive keyword dictionary to construct the BAI. The development of this dictionary is informed by the methodology and lexical framework employed in the creation of the New York Times Biodiversity News Index as described in Giglio et al. (2023). In addition, we adapt and refine this framework to align with Chinese linguistic



(a) Agriculture (b) Forestry

(c) Animal husbandry (d) Fishery

Fig. 1. The dynamic evolution diagram of the AFHF sectors during the full Sample Period.

Table 2
Biodiversity attention index keyword glossary.

Key word category	Primary key words	Secondary key words
Category 1	–	rainforest, forest, tree, desert, plant, freshwater, wetland, wild, coral, habitat, disafforest, carbon sink, inherit (14)
Category 2	**sea**	diversity, ecology, environment, life, species, protect, climate (7)
	species	diversity, bird, fish, environment, invade, protect, ecology, richness, endanger, threaten, population, directory (12)
	ecology	climate, environment, system, green, protect, environmental protection, pollute, govern, planting, repair, nature (11)
	tropical	diversity, ecosystem, environment, rainforest, species (5)
	resource	water, fish, bird, germplasm, nature, ecology (6)
	nature	climate, soil, city, green area, water, sustainable, environment, protect, recover, release, green, disaster, bird (12)
	biology	diversity, community, sea, migrate, class, inhabit, protect, species, grow, exist (10)
	animal	species, plant, protect, rare, endanger, inhabit, save, bird, exist, paradise (10)

conventions. Next, we incorporate high-frequency keywords from seminal documents in the biodiversity domain, including the Kunming Declaration and the China Biodiversity Conservation Strategy and Action Plan (2023–2030). To enhance contextual precision and minimize omissions, we systematically categorize keywords into a hierarchical structure consisting of 8 primary terms and 73 secondary terms.

Fig. 2 illustrates the index and highlights key biodiversity-related events. The index shows a general upward trend since 2013, indicating a growing public concern about biodiversity loss and conservation in China. In particular, the index peaks coincide with

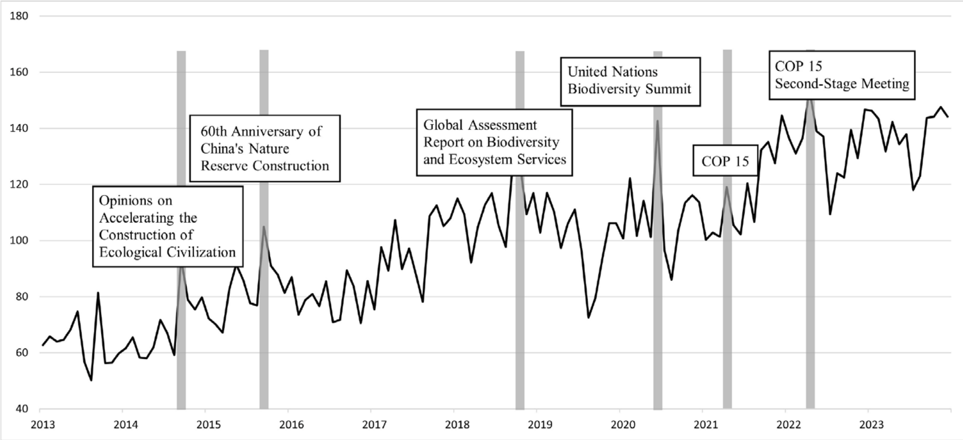


Fig. 2. Biodiversity attention index and events.

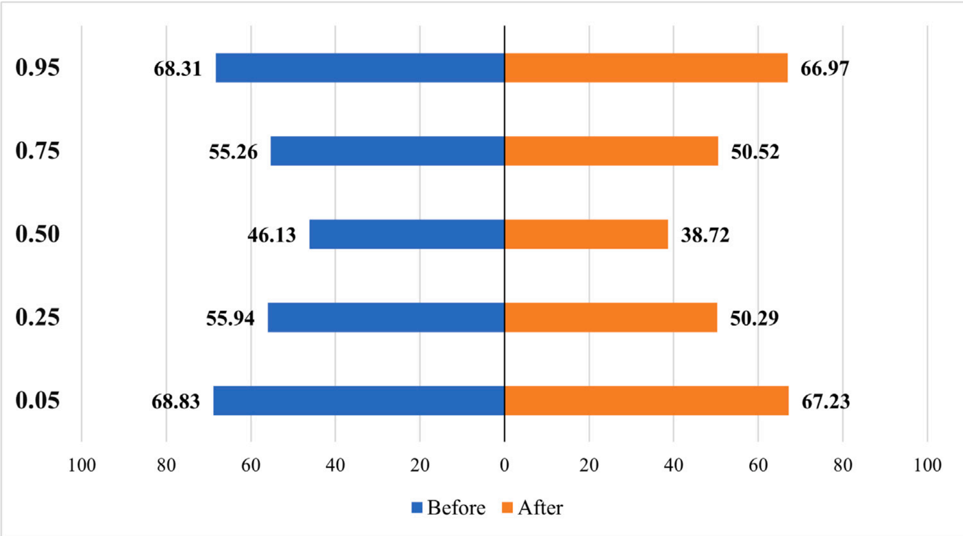


Fig. 3. The total spillover of the AFHF sectors before and after the Kunming Declaration at five quantiles.

significant biodiversity events, such as China hosting COP15. The release of the Kunming Declaration during the first phase of COP15 significantly raises public attention, which peaks after the Montreux Agreement in the second phase of COP15.

4. Empirical results

4.1. Static spillover analysis of the AFHF sectors before and after the kunming declaration

Existing research indicates that the release of the Kunming Declaration significantly increases public attention to biodiversity (Ma et al., 2024). To explore whether BAI affects total spillover among the AFHF sectors, we first examine changes in total spillover before and after the Kunming Declaration at five quantiles.

Fig. 3 illustrates the total spillover of the AFHF sectors at five quantiles before and after the Kunming Declaration. It should be noted that after the release of the Kunming Declaration, the total spillover of the AFHF sectors decreased. This is likely due to the fact that the Kunming Declaration can enhance public attention to biodiversity, and its commitment to reversing the trend of biodiversity loss will boost investors' confidence. Investors will have a greater preference for stocks that are beneficial to nature and companies with a lower biodiversity footprint (El Ouadghiri et al., 2025), thus protecting biodiversity and suppressing the total spillover among the AFHF sectors. However, in extreme market conditions, the impact of a single event on public attention may be limited, which may lead to the result that the difference in total spillover before and after the Kunming Declaration is the largest at the median quantile and decreases towards the extreme quantiles on both sides. Furthermore, consistent with the findings in Ang and Bekaert (2002), the extreme tail connectivity of the AFHF sectors is significantly higher than at the median.

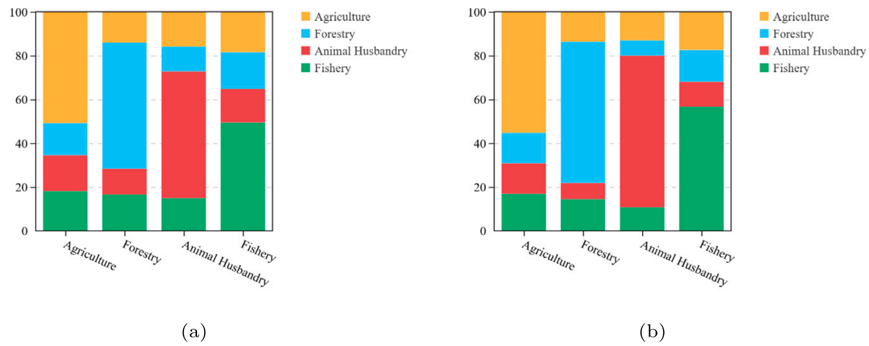


Fig. 4. Cumulative spillovers of biodiversity attention before and after the Kunming Declaration at 0.5 quantile: (a) Before, (b) After.

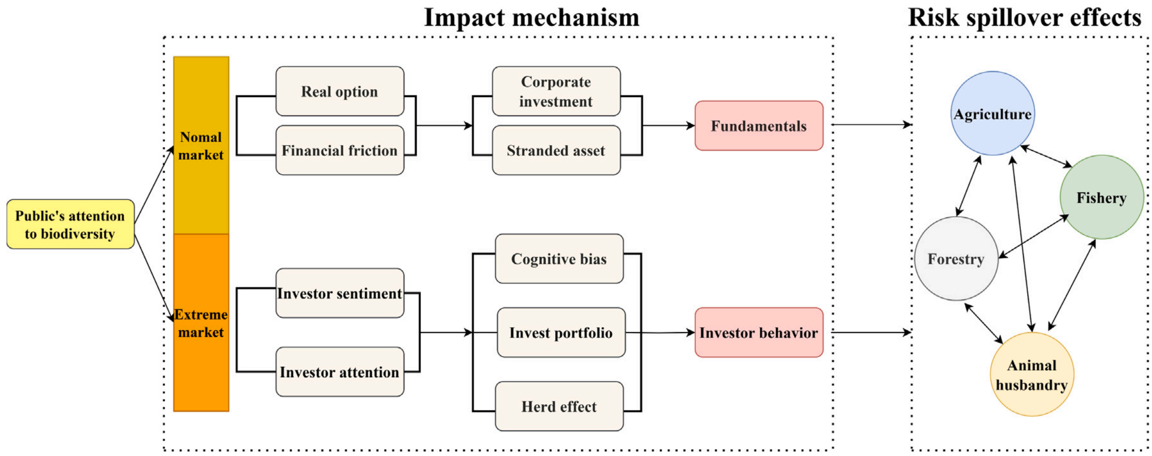


Fig. 5. Theoretical mechanism framework.

Considering that the total spillover at 0.5 quantile varies most among the five quantiles, we conduct further research on the pairwise spillover effects of the AFHF sector in the normal market state. Figs. 4(a) and 4(b) respectively present the results of cumulative spillovers before and after the Kunming Declaration at 0.5 quantile. The results indicate that after the Kunming Declaration, the spillover among the AFHF sectors decreased, while the spillover within each sector increased. The possible reasons can be as follows. Government and international organizations issued the Kunming Declaration with the aim of implementing environmental policies to mitigate biodiversity risks (Tian and Chen, 2025b), and restricting the use of certain natural resources (Liu, 2023). These actions have promoted the formation of clearer boundaries for resource utilization among sectors, reducing the transmission risk of negative shocks across sectors. At the same time, the Declaration strongly encourages companies to operate more sustainably (Yuan and Zhang, 2020). The increased public attention to biodiversity may intensify their premium requirements for the stock market with respect to biodiversity risks, thus exerting more pressure on companies for green transformation and causing increased competition and spillover within each sector.

4.2. Impact of biodiversity attention on the risk spillover of the AFHF sectors

To further quantify the impact of biodiversity attention on the risk spillover effects among the AFHF sectors, we integrate the monthly BAI as a low-frequency variable into the GARCH-MIDAS model. The model is stable across all quantiles, with $\alpha + \beta < 1$. The slope parameter θ in the MIDAS model is significant.

Fig. 5 shows the theoretical mechanism of how public attention to biodiversity impacts the effects of spillover risk in the AFHF sectors. In the normal market, according to the real option theory, corporate investment is irreversible. Considering the uncertainties caused by biodiversity, companies in the AFHF sectors are likely to delay related investments and maintain a cautious and watchful attitude (Trinh, 2023). The AFHF sectors are the most exposed to biodiversity risks in China (He et al., 2024). An increase in public attention to biodiversity will generate a financial friction effect. The increase in information costs may lead to an increase in corporate financing costs and stranded assets (Li et al., 2022). These phenomena may cause an imbalance in the fundamentals of the AFHF sectors, increasing the spillover effect. In extreme market conditions, investors' irrational traits become more pronounced.

Table 3
GARCH-MIDAS estimation results of the total connectivity of the AFHF sectors at different quantiles.

	μ	α	β	θ	ω	m
0.95	0.897***	0.570***	0.260***	−0.006**	1.133***	0.010***
	(0.001)	(0.062)	(0.044)	(0.003)	(0.315)	(0.003)
0.5	0.032***	0.739***	0.238***	17.423	1.577***	−17.430
	(0.001)	(0.030)	(0.016)	(16.226)	(0.087)	(16.235)
0.05	0.905***	0.588***	0.290***	0.002	27.387	0.001
	(0.001)	(0.063)	(0.043)	(0.002)	(100.280)	(0.002)

Table 4
GARCH-MIDAS estimation results of the risks emitted by the agriculture, forestry, animal husbandry, and fishery sectors under different quantiles.

		μ	α	β	θ	ω	m
0.95	Agriculture	0.673***	0.499***	0.165***	−0.203**	1.001***	0.244***
		(0.003)	(0.051)	(0.038)	(0.025)	(0.033)	(0.030)
	Forestry	0.670***	0.697***	0.274***	−1.383	1.001***	1.605
		(0.002)	(0.030)	(0.016)	(16.226)	(0.087)	(16.235)
	Husbandary	0.645***	0.607***	0.368***	−1.297	1.008***	1.459
		(0.002)	(0.024)	(0.010)	(1.082)	(0.027)	(1.213)
	Fishery	0.032***	0.739***	0.238***	17.423	1.577***	−17.430
		(0.001)	(0.030)	(0.016)	(16.226)	(0.087)	(16.235)
0.5	Agriculture	0.472***	0.677***	0.247***	−0.074	1.805**	0.100
		(0.002)	(0.086)	(0.059)	(0.071)	(0.986)	(0.087)
	Forestry	0.383***	0.665***	0.252***	0.046	1.710**	−0.024
		(0.002)	(0.092)	(0.050)	(0.043)	(0.977)	(0.034)
	Husbandary	0.293***	0.629***	0.281***	−0.066	1.032***	0.086
		(0.002)	(0.073)	(0.054)	(0.056)	(0.230)	(0.191)
	Fishery	0.481***	0.777***	0.162***	−0.040	49.998	0.076
		(0.002)	(0.096)	(0.062)	(0.052)	(182.170)	(0.091)
0.05	Agriculture	0.709***	0.764***	0.212***	2.441	49.737	−2.425
		(0.001)	(0.020)	(0.014)	(1.849)	(35.224)	(1.840)
	Forestry	0.664***	0.625***	0.324***	0.837*	1.574***	−0.794*
		(0.001)	(0.037)	(0.019)	(0.471)	(0.136)	(0.448)
	Husbandary	0.632***	0.652***	0.244***	1.153***	1.399***	−1.101*
		(0.002)	(0.048)	(0.026)	(0.430)	(0.053)	(0.411)
	Fishery	0.703***	0.644***	0.311***	1.304*	3.068***	−17.430*
		(0.001)	(0.036)	(0.024)	(0.529)	(0.169)	(16.235)

Public attention to biodiversity is more likely to affect investors' emotions and attention, and then influence investors' cognition, investment portfolio decision making behavior, intensify herd effect, and thus act on spillovers in the AFHF sectors.

As shown in Table 3, we observe the impact of biodiversity attention on the total spillover of the AFHF sectors at the three quantiles. At the 0.05, 0.5, and 0.95 quantiles, the values of θ are −0.006, 17.423, and 0.002, respectively. We find that biodiversity attention significantly inhibits the total spillover of the AFHF sectors at the 0.95 quantile. This is likely due to the fact that, in an extreme upward market state, investors are full of confidence. The more people pay attention to biodiversity, the more likely they are to take positive actions, such as fully measuring biodiversity risk and improving investment portfolios that hedge biodiversity risk (Giglio et al., 2023), to deal with potential risks, thus reducing the spillover effect. In contrast, in an extremely downward market, attention to biodiversity exacerbates risk spillovers. In a normal market state, due to limited attention, both investors and enterprises are mostly risk neutral and pay more attention to macroeconomic fundamentals. Therefore, their response to the attention to biodiversity is weakened and thus this impact is not significant.

Table 4 presents the impact of the attention to biodiversity on the transmission of risk from agriculture, forestry, animal husbandry, and fishery at the three quantiles. We find an interesting phenomenon: In extreme upward market states, biodiversity attention can inhibit the risk transmission of agriculture; however, in extreme downward market states, it promotes the risk transmission of forestry, animal husbandry, and fishery.

The reason can be attributed to the fact that in extreme upward market states, market expectations are good, and investors may mainly focus on the great increase in agricultural productivity over recent decades (IPBES, 2019), which leads to cognitive biases. However, increased attention to biodiversity will make investors aware that the disappearance of pollination vectors in biodiversity loss will lead to a decrease in agricultural productivity (Giglio et al., 2024), which is an issue that cannot be ignored, as hundreds of billions of dollars of global agricultural production value are based on insect pollination (Bosch, 2022). It can correct investors' cognitive biases, so that they can take action to inhibit agricultural risk contagion before biodiversity loss causes huge economic losses. Therefore, to reduce losses, investors can allocate funds to agricultural companies with robust biodiversity-related strategies, as they have a lower risk of abrupt declines in stock prices (Bassen et al., 2024).

However, in an extreme downward market, the market sentiment is low, and the more people pay attention to biodiversity, the more likely it is to cause great worry and panic. China is one of the countries most severely threatened by biodiversity loss (Wang et al., 2020), which makes it easier for investors to believe that the Chinese stock market has not or has not fully priced biodiversity risks (Giglio et al., 2023). Investors begin to require risk premiums, which is likely to form a herd effect, causing stock price fluctuations and intensifying the risk-emission effect of the four sectors. However, since agriculture plays the role of a "ballast stone" in China's economic development, investors are more likely to believe that the country will introduce policies to help agriculture develop smoothly (Zhang et al., 2024) and stabilizes stock prices, the risk transmission effect of agriculture is not significant compared to the other three sectors. It helps investors to take agricultural investments into account as a risk-hedging tool for their investment portfolios.

5. Conclusion

The paper analyzes how the attention paid to biodiversity impacts risk spillovers in the AFHF sectors. First, the total spillover effect in the AFHF sectors has decreased significantly following the release of the Kunming Declaration. The spillover among the four sectors decreases, while the spillover within the sectors increases in the normal market. Second, increased public attention on biodiversity has been found to suppress the total spillover effect in AFHF sectors during extreme upward market conditions, while its impact exacerbates but remains insignificant during normal and extreme downward market conditions. Lastly, increasing attention to biodiversity during periods of extreme increase tends to mitigate the transmission of risk in agriculture. In contrast, during extreme downward market conditions, it exacerbates risk transmission in the forestry, animal husbandry, and fishery sectors.

Based on our findings, we propose several recommendations for policy makers and investors. On the one hand, policymakers should strengthen the regulatory management of the forestry, animal husbandry, and fishery sectors and require relevant companies to enhance the disclosure of biodiversity-related information to reduce investors' panic during downward periods. On the other hand, investors need to enhance their attention to biodiversity during extreme upward periods to avoid losses caused by overconfidence. They should also pay attention to differences in subsectors within the AFHF sectors. During extreme downward periods, investors should be alert to exacerbated risk transmission in the forestry, animal husbandry and fishery sectors and conduct a cautious evaluation when making investments.

Future research could further investigate how biodiversity attention is priced in the stocks of agriculture-related sectors and develop more comprehensive policy recommendations to guide investors towards risk avoidance.

CRediT authorship contribution statement

Min Zhang: Writing – original draft, Visualization, Methodology. **Guorong Chen:** Writing – review & editing, Investigation, Data curation. **Jing Deng:** Writing – review & editing, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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