



From Geopolitics to Market Sentiment: Explaining Tin Price Bubbles with GSADF Approach

Jinglin Zhao¹, Qiulin Yang^{2,*}

¹School of Humanities and Social Science, The Chinese University of Hong Kong (Shenzhen), 518172, Shenzhen, China

²Business School, Shenzhen Technology University, 518118, Shenzhen, China

*Corresponding author and Co-first author:
yangqiulin@sztu.edu.cn

Abstract. With the rapid development of the new energy vehicle (NEV) industry, the strategic importance of tin has become increasingly prominent. In recent years, the persistent imbalance between tin supply and demand has attracted widespread attention in global markets. This paper examines the formation and dissipation of speculative price bubbles in the tin market, investigating the underlying drivers that contribute to these phenomena. Using daily futures settlement prices from April 1, 2015, to June 30, 2025, obtained from the WIND database, this paper applies the Generalised Supremum Augmented Dickey–Fuller (GSADF) method to detect periodic bubble behaviour in tin prices empirically. It analyses the driving mechanisms by tracing the temporal evolution of these bubbles. The results indicate that three categories of factors primarily drive bubble formation: (1) geopolitical risks, (2) domestic macroeconomic policies and institutional arrangements, and (3) social and market behaviours. These factors indirectly fuel tin price surges by influencing supply or demand dynamics. Moreover, emotional volatility in financial markets and the amplification of irrational economic behaviour contribute to the accumulation and expansion of price bubbles.

Keywords: Tin; Nonferrous Metal; Price Bubbles; GSADF.

1 Introduction

Tin has long held a significant position in the national economy due to its excellent physicochemical properties and broad range of applications [19]. In recent years, with the rapid advancement of new energy technologies, ongoing research has focused on tin's role in enhancing the energy storage efficiency of lithium batteries, further highlighting its strategic value in the context of "carbon neutrality" [3]. Amid growing geopolitical risks and economic policy uncertainties, the prices of non-ferrous metals have exhibited considerable volatility. Tin prices, in particular, are highly susceptible to dramatic fluctuations driven by a combination of supply-demand imbalances, market sentiment, and financial speculation. These factors can lead to the formation of price

bubbles, potentially undermining market stability. Against this backdrop, accurately identifying price bubbles holds substantial practical significance. On the one hand, it helps mitigate potential losses faced by investors and commodity traders during bubble bursts [4]; on the other hand, it provides policymakers with theoretical foundations and technical tools to intervene in markets and regulate systemic risks [14].

At present, a growing body of research has employed the BSADF method to investigate price bubbles in commodity markets. Representative commodities such as crude oil [25], corn and soybeans [13], as well as bananas, cocoa, and orange juice [18], have been frequently studied. In the metals sector, substantial attention has been given to precious metals [15] and certain non-ferrous metals [18, 22]. Scholars generally agree that, for non-ferrous metal markets, industry standards should be established based on the evolutionary characteristics of price bubbles, alongside the development of dynamic early warning systems [27]. Regarding tin, existing studies have identified the presence of price bubbles before December 2021. However, due to variations in time intervals and sample sizes, significant discrepancies remain among research findings, indicating that further exploration in this field is still warranted.

In addition, research on the factors influencing tin price volatility remains relatively limited. Amalia et al. [2] used a linear regression approach to find that inflation and forward prices have a significant impact on tin futures contract prices. Zhu et al. [27], employing a mode decomposition counterfactual analysis method, argued that changes in China's export policies can trigger short-term fluctuations in LME tin prices. Zhao [26], through a TVP-VAR model, suggested that geopolitical risks tend to generate short-term shocks to the prices of most natural resources. These studies indicate that a range of macroeconomic and geopolitical factors may drive tin price volatility. Building on this literature, the present study aims to explore further the key drivers behind the formation of tin price bubbles, thereby addressing a notable gap in existing research.

Despite the abundance of existing research and key references, this paper makes two main marginal contributions. First, based on daily closing prices of tin futures from April 1, 2015, to June 30, 2025, this paper employs the Generalised Supremum Augmented Dickey–Fuller (GSADF) test to detect the presence of price bubbles at any frequency [20]. Second, by linking the identified bubble periods with their corresponding time windows, this paper systematically analyses the potential drivers behind speculative bubbles in the tin market. The findings provide both theoretical and empirical support for the development of monitoring and early warning mechanisms targeting price bubble risks in non-ferrous metal markets.

2 Theoretical Model and Methodology

2.1 The Asset Pricing Model

This paper draws on asset pricing theory to explore cyclical bubble behavior linked to market fundamentals [11]. Prior models suggest that even mild explosive trends can cause prices to deviate from intrinsic values [21], while fundamental valuation is primarily governed by non-arbitrage conditions [7].

$$P_t = (1 + r_f)^{-1} E_t(\delta_{t+1} + U_{t+1}) \tag{1}$$

Let P_t and E_t denote the tin price and its expected value at time t , and r_f the risk-free rate. $\delta_t + 1$ represents earnings, while $U_t + 1$ captures unobservable factors in period $t + 1$. Through forward iteration, the pricing equation becomes:

$$P_t^f = \sum_{u=0}^{\infty} \left(\frac{1}{1+r_f}\right)^u E_t(\delta_{t+u} + U_{t+u}), \text{ for } u = 0,1,2, \dots, n. \tag{2}$$

Here, P_t^f represents the fundamental price of tin, and δ_{t+u} represents the earnings in period $t + u$. The factors determining the fundamental value are outlined in Equation (2). On the other hand,

$$B_t = (1 + r_f)^{-1} E_t(B_{t+1}) \tag{3}$$

Equation (3) shows any random variable sequence that meets the homogeneous expectation equation. As a result, Equation (1) can be rewritten as:

$$P_t = P_t^f + B_t. \tag{4}$$

Equation (4) decomposes the tin price into two components: P_t^f , the fundamental value, and B_t , the bubble component. When $B_t \neq 0$, prices deviate from fundamentals due to agents' expectations of selling at higher future prices. The bubble path is not unique; Equation (4) captures multiple possible trajectories of non-fundamental price behavior. If $B_t = 0$, no boom-bust dynamics are present. Conversely, a non-zero B_t implies ongoing explosive growth that eventually collapses. Therefore, identifying such cyclical bubble patterns is essential for informing policy responses in the face of extreme market conditions.

2.2 Date Stamping Multiple Bubble Episodes and Examination of Bubble Determinants

Traditional methods often fail to capture bubble dynamics when price series exhibit recurrent collapses [5]. Under the explosive alternative hypothesis, stationarity is typically tested using the standard ADF and Phillips–Perron approaches. However, given that:

$$\Delta P_t = \alpha + \beta P_{t-1} + \sum_{i=1}^k \gamma_i \Delta P_{t-i} + \epsilon_i, \quad \epsilon_i \sim NID(0, \sigma^2). \tag{5}$$

In this context, P_{t-1} denotes the lagged tin price, NID indicates a normally and independently distributed error term, and k indicates the number of lags. Under the null hypothesis $\beta = 1$, the series follows a unit root process; by contrast, the alternative $\beta < 1$ reflects the presence of mildly explosive boom-bust dynamics. However, as Evans [5] points out, standard unit root tests are limited in detecting such transitions due to sensitivity when the process switches between a unit root and a mildly explosive state. To overcome this, Phillips and Yu [17] introduced the Supremum ADF (SADF) test, which utilizes the maximum of recursively computed ADF T-statistics. The SADF

employs a forward-expanding window, where the sample size rw increases from r_0 to 1. The starting point r_1 is fixed at 0, while the endpoint r_2 matches rw within the interval $[r_0, 1]$. The SADF statistic is defined as:

$$\text{SADF}(r_0) = \sup_{r_2 \in (r_0, 1)} \{ \text{ADF}_{r_2} \}. \tag{6}$$

The SADF test loses power when multiple bubbles occur. To address this, Phillips et al. [16] proposed the GSADF test, which varies both the starting and ending points of the window. By allowing the start point to range from 0 to $r_2 - r_0$, $\text{GSADF}(r_0)$ better captures multiple episodes of explosiveness.

$$\text{GSADF}(r_0) = \sup_{r_1 \in (0, r_2 - r_0)} \{ \text{ADF}_{r_1}^{r_2} \} \tag{7}$$

If $\text{GSADF}(r_0)$ exceeds the critical value (CV) from Monte Carlo simulations, a boom-bust cycle is detected. With an intercept and a random walk null, the limiting distribution of $\text{GSADF}(r_0)$ is given by:

$$\sup_{\substack{r_2 \in (r_0, 1), \\ r_1 \in (0, r_2 - r_0)}} \left\{ \frac{(1/2)r_y [y(r_2)^2 - y(r_1)^2 - \int_{r_1}^{r_2} y(r) dr [y(r_2) - y(r_1)]]}{r_y^{1/2} \left\{ r_y \int_{r_1}^{r_2} y(r)^2 dr - \left[\int_{r_1}^{r_2} y(r) dr \right]^2 \right\}^{1/2}} \right\} \tag{8}$$

Here, $ry = r_2 - r_1$. Finite-sample distributions are obtained via bootstrap, while asymptotic critical values rely on numerical simulation.

Once bubbles are confirmed, we use the backward SADF (BSADF) method proposed by Phillips et al. [16] to consistently date-stamp boom-bust cycles in tin prices. The BSADF statistic is defined as:

$$\text{BSADF}(r_0) = \sup_{r_1 \in (0, r_2 - r_0)} \{ \text{ADF}_{r_1}^{r_2} \} \tag{9}$$

For the k -th bubble, the starting point r_k^s and ending point r_k^e are identified based on BSADF (r_0):

$$\widetilde{r}_{ks} = \inf_{r_2 \in [r_0, 1]} \left\{ r_2 : \text{BSADF}_{r_2}(r_0) > cv_{r_2}^{\beta T} \right\} \tag{10}$$

$$\widetilde{r}_{ke} = \inf_{r_2 \in [\widetilde{r}_{ks} + \delta \log(T)/T, 1]} \left\{ r_2 : \text{BSADF}_{r_2}(r_0) < cv_{r_2}^{\beta T} \right\} \tag{11}$$

Here, the $cv_{r_2}^{\beta}$ is derived from Monte Carlo simulations using a subset of the sample, and its threshold depends on the data frequency. Following prior studies, the bubble indicator variable R_t is defined based on the BSADF statistic. If the BSADF value at time t exceeds the corresponding critical value, a bubble will be identified; otherwise, no bubble will be detected.

3 Data

To investigate the causes of tin price fluctuations, this paper uses daily closing price data of tin futures from the WIND database, covering April 1, 2015, to June 30, 2025, with 2,491 observations. Table 1 presents the descriptive statistics. Tin prices show significant volatility and dispersion, with a slightly right-skewed distribution indicating concentration in lower ranges. Although the kurtosis is near the normal value, the Jarque-Bera test rejects normality, suggesting the series is affected by short-term market shocks or localized speculative behavior.

Table 1. Descriptive statistics of the tin price.

Indicators	Tin price
Start point	2015-04-01
End point	2025-06-30
Observation	2491
Mean	177899.9
Median	146610.0
Maximum	391660.0
Minimum	81500.00
Std. Dev.	60420.39
Skewness	0.814288
Kurtosis	2.830333
Jarque-Bera	278.2702

Table 2. Results of the SADF and GSADF tests.

		Critical value at 90%	Critical value at 95%	Critical value at 99%
SADF	4.900***	1.350	1.630	2.160
GSADF	4.920***	2.290	2.470	2.900

4 Empirical Results

Table 2, the SADF statistic for tin prices is 4.90, significantly exceeding the corresponding critical values (1.35, 1.63, and 2.16), thereby rejecting the null hypothesis of no explosive behaviour at the 1% significance level [23]. Similarly, the GSADF statistic is 4.92, which also surpasses its critical value of 2.90, further confirming the presence of explosive dynamics in tin prices. These results suggest that multiple price bubbles occurred during the sample period. To identify the specific timing of these episodes, a date-stamping strategy is employed. As shown in Figure 1, four bubble episodes are identified, three of which are short-lived (less than three days) and likely driven by brief speculation. This study focuses on the main bubble from July 16, 2021, to April 22, 2022, for further analysis.

The emergence of tin price bubbles is closely related to market supply–demand imbalances. As shown in Figure 1, the bubble period from July 2021 to April 2022 is

divided into two phases: Phase I (July–December 2021) and Phase II (January–April 2022). During Phase I, significant supply-side disruptions in the tin market were observed, primarily driven by two major events. First, the outbreak of COVID-19 severely disrupted global tin supply chains. China primarily imports tin ore and refined tin from Southeast Asian countries, including Myanmar, the Democratic Republic of the Congo, Indonesia, and others [9]. However, in the first half of 2021, the rapid spread of COVID-19 variants across Southeast Asia caused major shocks to regional economies and logistics systems. As of June 2021, 135 countries and regions in Southeast Asia were affected to varying degrees, with Indonesia reporting the second-highest number of confirmed cases in Asia [1]. In response, many countries imposed lockdowns, restricted labor mobility, and temporarily shut down factories and mines, severely impacting tin mining and smelting operations. These disruptions significantly reduced global tin supply by impeding international resource flows. Second, domestic tin smelting capacity in China also experienced temporary interruptions. On June 28, 2021, a subsidiary smelter of Yunnan Tin Company Limited announced a shutdown for maintenance expected to last 45 days. Given the already tight overseas supply, this interruption—by the world’s largest tin ingot producer—constrained market supply and accelerated inventory depletion of tin products, intensifying global supply shortages.

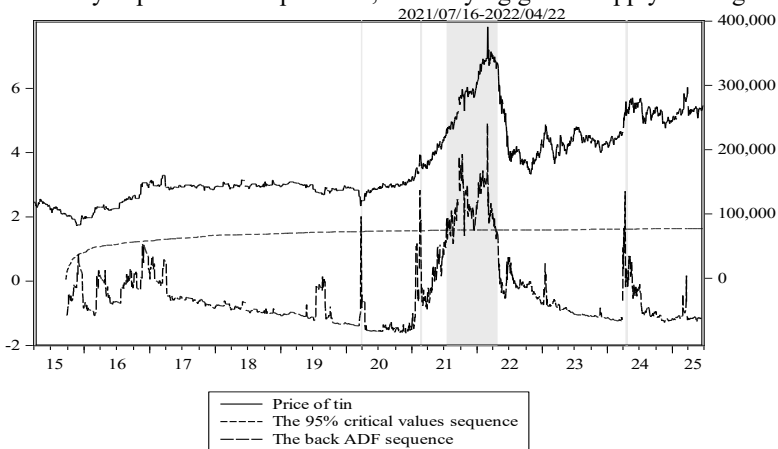


Fig. 1. Date-stamping bubble periods in the tin price.

Corresponding to tightening supply, the second half of 2021 also witnessed a sharp rise in tin demand in both China and the global market. First, China’s ongoing support for the new energy vehicle (NEV) industry significantly boosted demand for automotive batteries. Tin is a key raw material in lead–acid batteries [12]. The national policy document *New Energy Vehicle Industry Development Plan (2021–2035)* explicitly calls for accelerating NEV development and establishing an efficient recycling system for power batteries. This policy injection strengthened confidence across the NEV value chain. According to data released by the Ministry of Industry and Information Technology (MIIT), from January to August 2021, China’s lead–acid battery output reached 1.55187 billion kVAh—an 18.7% year-on-year increase. This substantial growth indicates strong domestic demand for lead–acid batteries, thereby driving up tin

consumption. Second, on a global scale, trade in goods and services recovered rapidly in 2021, signaling a broad economic rebound. According to SQ-CI data, electronic product output surged in the EU, UK, South Korea, and Japan during the second half of 2021, with the EU registering a year-on-year increase of over 40%, showing the most pronounced growth. As tin is widely used in the manufacturing of consumer electronics, such as computers and smartphones [9], the production expansion in these countries has significantly increased import demand for tin to meet the rising needs of manufacturing and consumption.

In summary, the first phase of the tin price bubble (the second half of 2021) was characterised by a pronounced supply–demand imbalance. On the supply side, the dual impact of the COVID-19 pandemic and production halts by major global tin producers significantly constrained global supply capacity. On the demand side, the gradual global economic recovery and the introduction of supportive policies—such as China's new energy vehicle initiatives—led to a sharp rise in tin consumption. The combined effect of restricted supply and surging demand created a clear supply shortage in the tin market, driving futures prices sharply upward and increasing volatility. These conditions contributed directly to the formation of the price bubble during this period.

During the second phase of the tin price bubble (January–April 2022), the tin market was influenced by both domestic and international economic and political factors. Domestically, seasonal factors played a key role. Due to traditional Chinese New Year customs and pre-holiday stocking behavior, downstream industries typically build up inventories in advance to meet post-holiday production needs [10]. As noted earlier, global tin supply was already under strain in the second half of 2021. This concentrated domestic restocking further tightened supply conditions, pushing up futures prices and accelerating the buildup of the bubble. In addition, strict regulations on the use of explosives were implemented in February 2022 to ensure air quality during the Beijing Winter Olympics [6]. As a result, the approval process for explosives needed by the Yinman tin mine in Inner Mongolia was delayed, postponing the resumption of operations until early March. Both situations resulted in temporary supply shock, combined with an already imbalanced market, deepened concerns over domestic tin availability and contributed to sustained price increases in the futures market.

Meanwhile, the global political and economic landscape became increasingly volatile. On February 24, 2022, the Russia–Ukraine conflict officially broke out, further amplifying uncertainty across global commodity markets. As a resource-rich country with strategic geopolitical importance, Russia plays a vital role in international raw material exports, including tin, nickel, oil, natural gas, and other key minerals. In addition, macroeconomic instability and geopolitical tensions significantly disrupted global logistics and supply chains [8]. On one hand, the conflict led to labor shortages in manufacturing sectors, further hindering the extraction and supply of metals such as tin. On the other hand, sanctions imposed by several countries on Russian goods intensified trade barriers, causing shipping delays and raising logistics costs, thereby constraining the global supply of tin ore. Notably, the conflict also triggered extreme volatility in related metal markets. In March 2022, the London Metal Exchange experienced a short squeeze in nickel futures, with prices spiking to a historic high of 100,000 dollars per ton. Given the increasing price linkage among non-ferrous metal futures [24], tin prices

also surged due to spillover effects. The extreme movements in nickel not only reflected market fears of supply disruption but also fueled speculative sentiment across the broad metals market, amplifying tin price volatility and contributing to the accumulation of bubble risk.

Overall, during the second phase of bubble formation, tin prices were once again driven by a combination of domestic and international economic and political factors. Domestically, seasonal behaviors and regulatory policies exacerbated supply constraints between January and March 2022, leading to persistently high tin prices and a gradual upward trend. Internationally, heightened geopolitical uncertainty, particularly the Russia–Ukraine conflict, disrupted global resource allocation and logistics systems. At the same time, spillover effects in financial markets and amplified investor sentiment further inflated the tin price bubble throughout this period.

5 Conclusion

This paper employs the GSADF method to examine bubble behavior in tin futures settlement prices from April 1, 2015, to June 30, 2025. The results reveal multiple episodes of explosive price dynamics, primarily driven by three categories of factors. First, geopolitical risks played a critical role. From late 2021 to mid-2022, the outbreak of COVID-19 variants and the Russia–Ukraine war disrupted global tin mining and logistics, triggering supply shocks and rapid price increases. Second, macro-level policies and domestic institutional arrangements shaped the supply–demand balance. For instance, China’s NEV policies spurred battery demand, while explosive-use restrictions during the 2022 Winter Olympics delayed tin mine operations. These pressures intensified price volatility. Finally, social and market behaviors amplified bubble dynamics. Production halts, cultural factors, and post-pandemic trade recovery drove short-term demand spikes, while financial speculation and price spillovers detached tin prices from fundamentals, increasing bubble risk.

6 Limitation and Future Development

This paper employs an event-time alignment approach to explain the formation of the tin price bubble; however, it lacks empirical validation using quantitative tools. Future research will build upon this analysis by incorporating both macroeconomic and microeconomic variables for correlation analysis and applying multiple bubble detection methods to systematically evaluate the bubble cycles in the tin market.

Acknowledgements

This research is supported by the Natural Science Foundation of Top Talent of SZTU (grant number GDRC202432).

References

1. Aisyah, D.N., Mayadewi, C.A., Budiharsana, M., Solikha, D.A., Ali, P.B., Igusti, G., Kozlakidis, Z., Manikam, L., (2022). Building on health security capacities in indonesia: Lessons learned from the covid-19 pandemic responses and challenges. *Zoonoses and Public Health* 69, 757–767.
2. Amalia, S., Effendi, K.A., Riantani, S., (2024). The impact of macroeconomic factors on the volatility of tin commodity futures contract prices: Empirical study on inflation, interest rates, and forward prices. *Interest Rates, and Forward Prices* (July 31, 2024).
3. Azam, M.A., Safie, N.E., Ahmad, A.S., Yuza, N.A., Zulkifli, N.S.A., (2021). Recent advances of silicon, carbon composites and tin oxide as new anode materials for lithium-ion battery: A comprehensive review. *Journal of Energy Storage* 33, 102096.
4. Brooks, C., Prokopczuk, M., Wu, Y., (2015). Booms and busts in commodity markets: bubbles or fundamentals? *Journal of Futures Markets* 35, 916–938.
5. Evans, G.W., (1991). Pitfalls in testing for explosive bubbles in asset prices. *The American Economic Review* 81, 922–930.
6. Guo, Y., Deng, C., Ovaska, A., Zheng, F., Hua, C., Zhan, J., Li, Y., Wu, J., Wang, Z., Xie, J., et al., (2023). Measurement report: The 4-year variability and influence of the winter olympics and other special events on air quality in urban beijing during wintertime. *Atmospheric Chemistry and Physics* 23, 6663–6690.
7. Gürkaynak, R.S., (2008). Econometric tests of asset price bubbles: taking stock. *Journal of Economic surveys* 22, 166–186.
8. Krykavskyy, Y., Shandrivska, O., Pawłyszyn, I., (2023). A study of macroeconomic and geopolitical influences and security risks in supply chains in times of disruptions. *LogForum* 19, 423–441.
9. Li, H., Qin, W., Li, J., Tian, Z., Jiao, F., Yang, C., (2021). Tracing the global tin flow network: highly concentrated production and consumption. *Resources, Conservation and Recycling* 169, 105495.
10. Liu, K., Chen, Y., Zheng, W., (2022). Impact of covid-19 on china's coal imports: effects and solutions. *Transnational Corporations Review* 14, 31–45.
11. Lucas Jr, R.E., (1978). Asset prices in an exchange economy. *Econometrica: journal of the Econometric Society*, 1429–1445.
12. Malecha, D., Małecki, S., Jarosz, P., Kowalik, R., Żabiński, P., (2023). Recovery of pure lead-tin alloy from recycling spent lead-acid batteries. *Materials* 16, 5882.
13. Mao, Q., Ren, Y., Loy, J.P., (2021). Price bubbles in agricultural commodity markets and contributing factors: evidence for corn and soybeans in china. *China Agricultural Economic Review* 13, 22–53.
14. Ozgur, O., Yilanci, V., Ozbugday, F.C., (2021). Detecting speculative bubbles in metal prices: Evidence from gsadf test and machine learning approaches. *Resources Policy* 74, 102306.
15. Pan, W.F., (2018). Sentiment and asset price bubble in the precious metals markets. *Finance Research Letters* 26, 106–111.
16. Phillips, P.C., Shi, S., Yu, J., (2015). Testing for multiple bubbles: Historical episodes of exuberance and collapse in the s&p 500. *International economic review* 56, 1043–1078.
17. Phillips, P.C., Yu, J., (2011). Dating the timeline of financial bubbles during the subprime crisis. *Quantitative Economics* 2, 455–491.
18. Potrykus, M., (2023). Price bubbles in commodity market—a single time series and panel data analysis. *The Quarterly Review of Economics and Finance* 87, 110–117.

19. Simon, M., Schiffer, M., Walther, G., (2021). Integrated purchasing and production planning for a non-ferrous metal production network. *Omega* 98, 102136.
20. Su, C.W., Wang, K.H., Chang, H.L., Dumitrescu-Peculea, A., (2017). Do iron ore price bubbles occur? *Resources Policy* 53, 340–346.
21. Tirole, J., (1985). Asset bubbles and overlapping generations. *Econometrica: Journal of the Econometric Society*, 1499–1528.
22. Wahab, B.A., Adewuyi, A.O., (2021). Analysis of major properties of metal prices using new methods: Structural breaks, non-linearity, stationarity and bubbles. *Resources Policy* 74, 102284.
23. Wang, K.H., Su, C.W., Lobonț, O.R., Moldovan, N.C., (2020). Chinese renewable energy industries' boom and recession: Evidence from bubble detection procedure. *Energy Policy* 138, 111200.
24. Wei, Y., Bai, L., Li, X., (2022). Normal and extreme interactions among nonferrous metal futures: A new quantile-frequency connectedness approach. *Finance Research Letters* 47, 102855.
25. Yu, K., Zhang, Y., (2021). Booms and busts in the oil market: Identifying speculative bubbles using a continuous-time dynamic system. *Complexity* 2021, 8883416.
26. Zhao, J., (2023). Time-varying impact of geopolitical risk on natural resources prices: evidence from the hybrid tvp-var model with large system. *Resources Policy* 82, 103467.
27. Zhao, Y., Zhang, J., Zeng, D., (2024). Identification and contagion study of price bubbles in bulk nonferrous metals, in: 5th International Conference on Economic Management and Big Data Application (ICEMBDA 2024), Atlantis Press. pp. 29–37.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

