Asset Price Bubbles in Agricultural Commodities Futures Market

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Abstract

In this paper, the evolution of the asset price bubble was simulated by using NetLogo software, when the mean reversion traders and herd behavior traders in agricultural commodities futures market were affected by single asset sentiment and market sentiment. In the simulation experiment, this paper set the relationship network between multiple subjects, the decision rule of the mean reversion traders and the decision rule of the herd behavior traders, and gave the initial value for the single asset sentiment and market sentiment according to the set experimental environment. Meanwhile, the impact of key parameters of single asset sentiment and market sentiment on the evolution of asset price bubbles in agricultural commodities futures market was analyzed. The study found in agricultural commodities futures market that both single asset sentiment and market sentiment have a significant impact on asset price bubbles.

Key words: Agricultural Commodities Futures Market, Asset Price Bubble, Single Asset Sentiment.

1. Introduction

The asset price bubble reflects the degree of asset prices deviate from their intrinsic value. The asset price bubble will have a huge impact on the real economy and will easily evolve into a large-scale unemployment and economic crisis. From the “Tulip Mania” of the Netherlands in the 17th century to the global depression in the 1930s, and to the subprime crisis in 2008, the asset price bubble has always shown its enormous destructive power in different forms. In agricultural commodities futures market, there are also some commodities within a specific period of “boom collapse” price bubbles and extreme risk events, prices of agricultural commodities futures market swings have become a potential threat to the security of the world's agricultural industry. Although a large number of scholars on the in-depth study on the asset price bubbles, but as of today, asset price bubbles in agricultural commodities futures market have been bothering theoretical and practical problems.

In 1982, Blanchard and Watson proposed the rational bubble model [1], it was assumed that the financial market was effective, and investors could use all available information to make rational expectations on the market, and believed that even in the case of rational expectations, a positive feedback mechanism might be formed to promote the formation of bubble prices. Lux & Sornette [2] extended Blanchard & Watson's formula to establish a more general model of rational financial bubbles under the assumption of no arbitrage and randomness. PH Hendershott, RJ Hendershott, BD MacGregor [3] believed that the asset price bubble was mainly caused by cyclical sustained economic growth and a large economic downturn. The increase and decrease of cash flow with expected earnings deviated from the actual value of assets. A bubble occurs when the expected cash flow growth was higher than the actual economic growth, and conversely, the bubble burst. Because the hypothesis of the rational bubble model was far from the real market situation, and the development of behavioral finance made a more realistic interpretation of the deviation of stock prices from their intrinsic value. Therefore, the research on the formation mechanism of the subsequent asset price bubble was mainly carried out under the framework of behavioral finance. Kahneman [4] et al. first modeled investor preferences in “expectation theory”. Lux [5] believed that stock price fluctuation was due to the gradual change of optimism or pessimism that had become a contagion, affecting the process of investor judgment. Barberies, Shleifer & Vishny [6] argued in the proposed BSV model that the bubble was caused by the price of the security deviating from its fundamental value, which was actually caused by investor sentiment. Camerer & Lovallo [7] used
experimental methods to prove that optimism can affect economic behavior. Shleifer [8] further pointed out that noise traders who have the wrong idea of the future earnings of assets were the main incentives for risk. Of which, people always make optimistic judgments and decisions in a positive sentimental state, and make pessimistic judgments and decisions under negative sentiments. Akerlof [9] et al. developed the theory of animal spirits, arguing that collective irrational behavior driven by animal spirits (or natural instincts) led to asset price bubbles. The obvious manifestation is that, when there is a problem in the market, panic will lead to the collective cycle behavior of investors, which in turn increases stock price fluctuation. McMillian [10] used market sentiment to ease the deviation of stock price from its intrinsic value, and found that market sentiment was asymmetric. The intrinsic value support effect of stock price in the rising process far exceeded the falling process. Zhang & Liu [11] studied the hog price from June 1994 to April 2017, and found that the hog price may collapse rapidly from the middle price to the low price or increase rapidly from the low price to the medium price, but the rise from the medium price to the high price is much slower.

In the agricultural commodities futures market, Gilbert [12] studied the price bubbles of 3 kinds of agricultural commodities (wheat, maize and soybean) futures market, and discussed the impact of investment activities on the futures market bubble. Gutierrez [13] studied whether the price of agricultural commodities futures market deviated from its real value during the financial crisis. Areal [14] and other studies have found that export restrictions can exacerbate the emergence and bursting of agricultural asset price bubbles, while trading policies will have some impact on asset price bubbles. At present, the analysis of the causes of asset price bubbles in agricultural commodities futures market has not taken into account the influence of emotional factors in behavioral finance. Wang [15] found that the price of agricultural product market is highly dependent on the pricing strategy adopted by agricultural market traders. In fact, based on behavioral finance theory, the perception of traders in the market is limited. They cannot grasp all the data in the market, and are mainly affected by the investment decisions of other traders around them. They cannot observe the investment decision of all the traders in the market. Therefore, in the study of this paper, the traders in the agricultural commodities futures market are divided into herd behavior traders and mean reversion behavior traders, and the single asset sentiment is stripped out of the market sentiment, revealing the evolution mechanism of asset price bubbles under the interaction of single asset sentiment, market sentiment and herd behavior, mean reversion in the agricultural commodities futures market.

This paper will use NetLogo software to focus on the sentimental impact of individual trading entities in the agricultural commodities futures market, analyze the formation mechanism of asset price bubbles of the agricultural commodities futures market, and further reveal the impact of investor sentiment on the evolution of asset price bubbles in the agricultural commodities futures market.

2. Experiment Environment Hypothesis

NetLogo software, a simulation software that can perform multi-agent modeling, is mainly developed by the Computer Modeling Center (CCL) of UriWileny University in the United States. It can control tens of thousands of individuals at the same time in the modeling process, especially the complex process of mutual influence for the existence of transaction entities, and can analyze the formation process of asset price bubbles by observing the trading behavior of various entities in the market from the micro level. NetLogo software has the following advantages: (1) its programming is easier to use than other simulation software; (2) intuitively observe the trading decisions of market entities; (3) intuitively observe the process of asset price bubbles and asset returns.

In the process of experimental simulation, it is necessary to combine some basic operating conditions in the agricultural commodities futures market. The first thing to focus on is the traders in the market. The investment decisions they take will directly affect the changes in asset prices, and the decisions of individual investors in the market. The behavioral process is also difficult to reveal through mathematical models or real data, so it is necessary to reveal the investment decision behavior of individual trading entities in the market through experimental simulation. For the study of trader behavior, domestic and foreign scholars have carried out a lot of research, and herd behavior as a ubiquitous investor trading behavior has attracted the attention of scholars such as Stein and Scharfstein, Nakagawa and Oiwa, etc., Kaizoji and Leiss et al, Galariotis and Rong, Lakanishketal and Shleifer, Wermers, Lobao and Serra, Yao and Ma combined with data on financial markets in various countries and found that the market was full of herd behavior and reveals the impact of herd behavior to financial phenomena, but empirical test has a great disadvantage, and it can’t reveal whether the transaction individuals make investment decisions through mutual simulation, or accidentally form the same decision-making behavior through independent analysis. At the same time, many scholars at home and abroad have studied and proved that investor sentiment will have a certain impact on the evolution of asset price bubbles. In order to further analyze the influence of investor sentiment in the agricultural commodities futures market (single asset sentiment, market sentiment) and trading behavior on the evolution of asset price bubble, a
feasible way is to simulate the operation of real market by means of experimental simulation platform. It is possible to analyze the evolution of the asset price bubble when the mean reversion traders and the herd behavior traders in the agricultural commodities futures market are affected by the single asset sentiment and market sentiment from the micro level.

In order to ensure that the experimental simulation platform is more in line with the actual situation, this paper relaxes the calculation scope of single asset sentiment, market sentiment, herd behavior, etc. First, this paper believes that traders in the market have certain limitations for knowledge of single asset sentiment and market sentiment. In practice, it is also difficult to determine the single asset sentiment and market sentiment through the number of traders. Therefore, this paper will combine the network characteristics of NetLogo and believe that traders in the agricultural commodities futures market can only make decisions based on the investment situation of neighbors. Second, this paper believes that traders in the agricultural commodities futures market are heterogeneous, so it is necessary to relax the assumption that the parameters are fixed. Third, the fundamental value of assets is changing. Taking this as the basis of experimental simulation, the experimental environment hypothesis of this paper is proposed.

This experimental platform regards the asset trading market as a complex system. The traders in the agricultural commodities futures market are affected by various factors, and their investment decisions ultimately act on assets, while the supply and demand of assets reach equilibrium in the market operation process, and finally the asset price is formed. It can be seen that the investment decisions of the traders in the agricultural commodities futures market reflect the internal dynamics of the system, while the changes in asset prices reflect the external dynamics of the system, thereby forming an internal and external impact path that affects the generation of asset prices. Based on this, this paper divides the investors in the agricultural commodities futures market into mean reversion traders and herd behavior traders. Each investor has its own trading strategy, and their trading strategies interact with each other. Based on the above analysis, the experiment environmental assumptions of this paper is proposed:

1. Traders in the agricultural commodities futures market jointly chase an asset, and the market information is independently and equally distributed;
2. Traders in the agricultural commodities futures market include mean reversion traders and herd behavior traders, and are randomly distributed in the market according to a certain ratio;
3. Mean reversion traders have certain cognitive ability and comprehension ability, and make investment decisions based on their own understanding of asset value. However, their judgments will be overreacted by single asset sentiment and market sentiment;
4. Herd behavior traders do not care about the true value of assets, and make investment decisions based on the investment, market income and private information of neighbors;
5. The communication between transaction entities in the agricultural commodities futures market is based on a certain network topology of interpersonal relationships. Partial assumption the interpersonal relationship network between Agents is a regular network topology.
6. For the sake of simplicity, this paper assumes that the trader's state $s_i$ can only be chosen between 1, and -1, which indicates sentimental optimism or pessimism, buying or selling, bull or bear market, bullish or bearish.

3. Experimental Design

3.1. Multi-Subject Relationship Network

In the experimental simulation, it is necessary to analyze the relationship network between multiple entities in the agricultural commodities futures market, generally using the topology structure of the network with periodic boundary rules. Based on the trader structure in the experimental platform is analyzed, each node or the square represents the transaction subject, and its four nodes or squares are up, down, left, and right as neighbors, as shown in Figure 1. In combination with real agricultural commodities futures market, it is impossible for traders to understand the investment decisions of all other traders, and at the same time, they can understand the investment decisions of their neighbors. Therefore, it is believed that messages between the entities can only be transmitted through neighbors, but not through neighbors to influence. In order to get closer to the actual trading market situation, the neighbors in the upper left, lower left, upper right, and lower right directions of each node are respectively added to become the rule network topology structure with eight neighbors, as shown in Figure 2.

It can be seen from Figure 2 that each subject in the experimental simulation platform has 8 neighbors. In the actual trading environment, the trading entities often communicate with people around them and influence each other to form their own views on the future development of asset prices, and make investment decisions. The setting of 8 neighbors will be the most likely to development situation of being realistic. Based on the above analysis, this paper will use the two-dimensional rule network of eight neighbors to replace the relationship
between real market entities.

Under normal circumstances, the relationship network of traders in the actual agricultural commodities futures market will not change much in the short term, and the relationship network is relatively stable. In this paper, setting eight neighbors in the experimental platform is relatively stable and consistent with the actual situation. Therefore, in the experimental simulation, the network topology in the model is considered to remain unchanged.

3.2. Decision Rule of Mean Reversion Traders

When platform analyzes the investment decision of the mean reversion traders, it believes that such traders will invest in combination with the estimated intrinsic value. In the real agricultural commodities futures market, the inside and outside of the company are full of various kinds of information, which will affect the fundamental value of the assets to a certain extent. It can be seen that the fundamental value of the assets is also constantly changing. This paper assumes that the change in value (discounted future income) is subject to independent and identical distribution, and the fundamental value of the asset will satisfy the following equation:

\[
\ln(p_{t+1}^f) = \ln(p_t^f) + \delta_t
\]

Where: \(p_t^f\) is the fundamental value of the assets of the \(t\) period, \(p_{t+1}^f\) is the fundamental value of the assets of the \(t + 1\) period, \(\delta_t\) is the signal that affects the intrinsic value of the assets, and \(\delta_t \sim N(u, \sigma^2)\), which \(\mu\) is regarded as the inner property of the assets changes in value.

However, under normal circumstances, the mean reversion traders cannot know the fundamental value of the asset completely accurately. There is always a cognitive bias, such as excessively assessing the intrinsic value and forming overconfidence, and underestimating the intrinsic value and forming insufficient response. Based on this, this paper assumes that the mean reversion traders will estimate the base value \(p_t^f + \delta_t\) of the asset that he or she predicts to invest. When it is higher than the fundamental value, bearish; when it is lower than the fundamental value, bullish. Using the mathematical expression, the decision of the mean reversion traders is expressed as:

\[
S_{it} = \mathbb{I}(dec_{it} > 0) - \mathbb{I}(dec_{it} \leq 0), 1 \leq t \leq T
\]

3.3. Decision Rule of Herd Behavior Traders

When analyzing the investment decisions of the herd behavior traders, the experimental platform believes that such traders will make decisions based on the investment attitudes and market returns of neighbors. Assume that the herd behavioral trader \(i\) is affected by the surrounding neighbors' investment decisions to a degree of \(k_i\), subject to a random and even distribution \((0, k_{\text{max}})\). The decision-making behavior of the herd behavior traders \(i\) changes in real time with the influence of neighbors and market returns, namely \(k_i(t) = a(k_i(t-1) + \beta x(t-1)r(t-1))\). It can be seen that the investment decision of the herd behavior trader \(i\) is related to the gains of the neighbors in the previous period. If the investment decision of the previous period and the gain of the previous year are multiplied, the decision of the neighbors is beneficial to obtain the income.

In the next period, the reference weights to surrounding neighbors will be increased; conversely, if the neighbor's decision is contrary to the return, it will have a negative impact on the herd behavioral trader \(i\). In
addition, the herd behavioral trader $i$ is also affected by the previous decision-making behavior. Similar to the decision rule of the mean reversion traders, the degree of influence of the herd behavior traders $i$ on the decision of the market environment is represented by $b_i$, subject to random uniform distribution $(0, b_{\text{max}})$. $b_i$ varies with market returns, i.e. $b_i(t) = a b_i(t-1) + \beta r(t-1)$. This paper assumes that the trader's actions and decisions are influenced both by the outcome of the previous transaction and by the decisions of neighbors. In this way, the decision of the herd behavior traders can be expressed as:

$$S_{it} = I(\text{dec}_{ct} > 0) - I(\text{dec}_{ct} \leq 0), 1 \leq t \leq T$$

Where $\text{dec}_{ct} = \sum_{j=1}^{n} k_j(t) s_j(t-1) + b_i(t) r(t-1), 1 < t < T$, when the conditions in the brackets are satisfied, $I(\{}$ the value is 1, otherwise 0; $S_i = 1$ means bullish, $S_i = -1$ means bearish.

3.4. Model Pricing Mechanism

This paper focuses on the asset pricing mechanism of traders in the agricultural commodities futures market under the influence of single asset sentiment and market sentiment. The artificial stock market model based on Ising model proposed by Sornette and Zhou [16] is used, and the model is modified and finally utilized. The most commonly used price adjustment rules in Agent-based stock market modeling:

$$\ln(P_{t+1}) = \ln(P_t) + \frac{\sum_{i=1}^{N} S_i(t)}{\lambda N} + \epsilon_t$$

Where, $\epsilon_t$ is a random disturbance term affecting the asset price, $N$ is the total number of agents, and each grid point represents an Agent; the total number of Agents is $N=(L+1)^2$, and $L$ is the length of the center point as the core, extending from the up, down, left, and right; $\lambda$ is the market depth or indicates liquidity.

The above expression is an unbalanced pricing method, and its price is dynamically adjusted based on excess demand. The supply and demand of assets in the market is to sum up all the investment decisions in the market, namely $\sum_{i=1}^{N} S_i(t)$. If the total value of is positive, it means that the asset supply is less than the demand, and the price rises; if the total value is 0, it means the balance between supply and demand; if the total value is negative, it means that the asset supply is greater than the demand, and the price drops. There are other influencing factors in the market, which are represented by $\epsilon_t$ and conform to the log-normal random walk process.

4. Simulation of the asset price bubbles evolution

This paper will establish an asset price bubble evolution simulation platform in the agricultural commodities futures market, use the above experimental design to assign initial values for single asset sentiment, market sentiment, etc., and analyze the impact of key parameters of single asset sentiment and market sentiment on the evolution of asset price bubbles in the agricultural commodities futures market.

The basic parameter settings of the experimental simulation platform: network topology parameter $N=21 \times 21=441$, which indicate that there are 441 traders in the agricultural commodities futures market. Among them: $n$ grids are randomly set as mean reversion traders, and the remaining $441-n$ grids are used as herd behavior traders. The simulation main interface of the experiment is shown in Figure 3:

![Figure 3. Simulation main interface](image-url)
Combined with NetLogo software, the interface shown in Figure 3 is designed. The interface is divided into three areas: the left side is the output area of the experimental simulation data including the asset price bubble, asset price, yield, fundamental value, single asset sentiment. The statistics of parameters such as market sentiment facilitate the observation and debugging of real-time data during the experimental simulation. In the middle is the output area of the asset price bubble, asset price and yield time series, which facilitates the statistics and analysis of time series data during the experimental simulation. On the right is the investment attitude of each agricultural commodities futures market trader in the simulation environment, green (light) means the trader will sell the asset, and red (dark) means the trader will buy the asset. With the changes in the sentiment of single assets and market sentiment, the view of investors in the market is changing in real time.

4.1. Simulation of Asset Price Bubbles Based on Single Asset Sentiment

4.1.1. Single asset optimism sentiment (Experiment 1, 2, 3)

Let \( n = 110 \), \( \text{assetsentiment} = 0.1 \), and \( \text{marketsentiment} = 0 \), indicating that the number of mean reversion traders in the market is 110, the initial value of single asset optimism is 0.1, and the market sentiment is set to zero. After the parameter setting is completed, run the 1000 phase to get the simulation result as shown below:

![Figure 4](image)

**Figure 4.** Evolution of asset price bubbles and simulation of yields when the initial value of single asset optimism is 0.1

The first dialog in Figure 4 shows the evolution of the asset price bubble, the second dialog shows the fluctuations in the asset price and the fundamental value of the asset, and the third dialog shows the fluctuations in the return on the asset. Through analysis, it can be found that the asset price bubble is in a state of continuous generation, expansion and rupture, and the fluctuation is between -2.4 and 2. Under the influence of the optimism of single assets, the asset price and its fundamental value are rising.

In order to analyze the impact of the optimism of single assets on the evolution of asset price bubbles, the initial value of single asset optimism was further increased to 0.25 and 0.5, and the evolution of asset price bubbles in the simulation environment was analyzed.
It is found by analyzing the evolution of asset price bubbles under the optimism of two single assets in Figure 5 and 6 that, as the optimism of single assets, the fluctuation range of asset price bubbles increases; the asset price and the fundamental value of assets rise further, it can be foreseen, if the optimism of single assets continued to increase, market traders in the simulation environment were affected by their sentiments, which enhanced their enthusiasm for asset trading and led to an increase in asset prices.

4.1.2 Pessimistic sentiment of single assets (Experiment 4, 5, 6)

Let n=110, assetsentiment=-0.1, and marketsentiment=0, indicating that the number of mean reversion traders in the market is 110, the initial value of single asset optimism is -0.1, and the market sentiment is set to zero. After the parameters are set, run the 1000 phase to get the simulation results as shown below:
Figure 7. Evolution of asset price bubbles and simulation of yields when the initial value of pessimism for single assets is -0.1

It is found from analyzing Figure 7 that the asset price bubble is in a state of continuous generation, expansion, and rupture, and the fluctuation is between -2 and 2.63. Under the influence of pessimism of single assets, asset prices and their fundamental values are in the decline status.

In order to analyze the impact of the pessimistic sentiment of single assets on the evolution of asset price bubbles, the initial value of pessimism of single assets is further increased to -0.25, -0.5, and the evolution of asset price bubbles in the simulation environment is analyzed.

By analyzing the evolution of asset price bubbles under the pessimism of two single assets in Figure 8 and Figure 9, it is found that, with the increase of pessimistic sentiment of single assets, the fluctuation range of asset price bubbles increases; the asset prices and the fundamental value of assets decline further, it can be foreseen, if a single asset pessimism continues to increase, market traders in the simulation environment are affected by their sentiments. Asset prices will ultimately not reflect the fundamental value of assets, and the market is in an ineffective state.

Figure 8. Evolution of asset price bubbles and yield simulations when the initial value of pessimism for a single asset is -0.25
Figure 9. Evolution of asset price bubbles and simulation of yields when the initial value of pessimism for single assets is -0.5

4.2. Simulation of asset price bubbles based on market sentiment
4.2.1 Market optimism sentiment (Experimental Seven, Eight, Nine)

Let \( n=110 \), \( \text{asset sentiment}=0 \), and \( \text{market sentiment}=0.05 \), indicating that the number of mean reversion traders in the market is 110, the single asset sentiment is set to 0, and the market optimism initial value is set to 0.05. The market sentiment value set here is small, mainly considering that the market sentiment changes too much, which will have too much impact on the formation of assets, resulting in invalid asset prices. After the parameters are set, run the 1000 phase to get the simulation results as shown below:

Figure 10. Evolution of asset price bubbles and simulation of yields when the initial market optimism is 0.05

By analyzing Figure 10, we can find that the asset price bubble is in a state of continuous generation, expansion, and rupture. The fluctuation is between -2.77 and 2.6, and the asset price bubble is more in a positive bubble; under the influence of market optimism, the asset price and its fundamental value are on the rise.

In order to analyze the impact of market optimism on the evolution of asset price bubbles, the initial value
of market optimism is further increased to 0.1 and 0.15, and the evolution of asset price bubbles in the simulation environment is analyzed.

Figure 11. Evolution of asset price bubbles and simulation of yields when the initial value of market optimism is 0.1

Figure 12. Evolution of asset price bubbles and simulation of yields when the initial value of market optimism is 0.15

By analyzing the evolution of asset price bubbles under the two market optimisms in Figure 11 and Figure 12, it is found that, as the market optimism increases, the asset price bubble fluctuation range increases; asset prices and asset fundamental values rise further, it is foreseeable, if market optimism continues to enhance, market traders in the simulation environment are affected by their sentiments, and asset prices will continue to rise, which will have a certain impact on the future development of assets.

4.2.2. Market pessimism (Experiment 10, 11 and 12)

Let $n=110$, assetsentiment=0, and marketsentiment=$-0.05$, indicating that the number of mean reversion traders in the market is 110, the single asset sentiment is set to 0, and the market pessimistic initial value is set to
zero. After the parameters are set, run the 1000 phase to get the simulation results as shown in Figure 13:

![Figure 13. Evolution of asset price bubbles and simulation of yields when the initial market pessimism is -0.05](image)

By analyzing Figure 13, we can find that the asset price bubble is in an evolutionary state of continuous generation, expansion, and rupture, the fluctuation is between -3.77 and 2.51, and the asset price bubble is more in a negative bubble state; under the influence of market pessimism, the asset price and its fundamental value are in a decline state.

In order to analyze the impact of market pessimism on the evolution of asset price bubbles, the initial value of market pessimism is further increased to -0.1, -0.15, and the evolution of asset price bubbles in the simulation environment is analyzed.

![Figure 14. Evolution of asset price bubbles and simulation of yields when the initial market pessimism is -0.1](image)
By analyzing the evolution of asset price bubbles under the pessimism of the two markets in Figure 14 and Figure 15, it is found that, with the increase of market pessimism, the fluctuation range of asset price bubbles increases; the asset price and the fundamental value of assets decline further; it can be foreseen, if market pessimism continues to enhance, market traders in the simulation environment are affected by their sentiments, asset prices will ultimately not reflect the fundamental value of the assets, and the market is in an ineffective state.

4.3. Asset price bubble simulation based on the interaction between single asset sentiment and market sentiment

4.3.1 Market optimism sentiment of single asset optimism sentiment (Experiment 13)

Let \( n=110 \), asset\_sentiment=0.25, and market\_sentiment=0.1, indicating that the number of mean reversion traders in the market is 110, the initial value of single asset optimism is set to 0.25, and the initial value of market optimism is set to 0.1. After the parameters are set, run the 1000 phase to get the simulation results as shown in Figure 16.
By analyzing the 16 graphs, we can find that the asset price bubble is in a state of continuous generation, expansion, and rupture, and the fluctuation is between -2 and 3.18. The fluctuation of the bubble is greater than the optimism of the asset alone and the market optimism. The asset price bubble is more in a positive bubble; under the influence of the optimism of the single-asset optimistic market, asset prices and their fundamental values are on the rise. Under the influence of two types of optimism, asset prices are rising faster, and this state will have an adverse impact on assets.

4.3.2. Market pessimism sentiment of single asset optimism sentiment (Experiment 14)

Let \( n=110, \) assetsentiment=0.25, and marketsentiment=-0.1, indicating that the average number of traders in the market is 110, the initial value of single asset optimism is set to 0.25, and the initial value of market pessimism is set to -0.1. After the parameters are set, run the 1000 phase to get the simulation results as shown in Figure 17.

![Figure 17](image)

**Figure 17.** Evolution of asset price bubbles and simulation of yields when the initial value of single asset optimism and market pessimism is 0.25, -0.1, respectively

By analyzing Figure 17, we can find that the asset price bubble is in a state of continuous generation, expansion, and rupture. The fluctuation is between -4.66 and 2.72, and the fluctuation of the bubble is more intense, mainly because the single asset sentiment is optimistic, market sentiment is in the pessimistic state, and the concept of traders in the simulation market is extremely unstable. In the process of mutual game, the asset price bubble may burst rapidly and rapidly generate in the state of generation; under the influence of the pessimistic sentiment of the single asset optimistic market, the two types of sentiments promote each other, and the asset price is in a state of violent fluctuation. If it is in this state for a long time, it will have a great impact on the assets.

4.3.3 Market optimism sentiment of single asset pessimistic sentiment (Experiment 15)

Let \( n=110, \) assetsentiment=-0.25, and marketsentiment=0.1, indicating that the average number of traders in the market is 110, the initial value of pessimism for single assets is set to -0.25, and the initial value of market optimism is set to 0.1. After the parameters are set, run the 1000 phase to get the simulation results as shown in Figure 18.
By analyzing Figure 18, we can find that the asset price bubble is in an evolutionary state of continuous generation, expansion, and rupture. The fluctuation is between -2 and 4.19, and the fluctuation of the bubble is more intense, mainly because the single asset sentiment is in a pessimistic state, market sentiment is in an optimistic state, and the concept of traders in the simulation market is extremely unstable. In the process of mutual game, the asset price bubble may burst rapidly and rapidly generate in the state of generation; under the influence of optimism in the pessimistic market of single assets, the two types of sentiments promote each other, and the asset price is in a state of violent fluctuation. If it is in this state for a long time, it will have a great impact on the assets.

4.3.4 Pessimistic sentiment of single asset pessimistic market (Experiment 16)

Let n=110, asset_sentiment=-0.25, and market_sentiment=-0.1, indicating that the number of returning traders in the market is 110, the initial value of pessimism for single assets is set to -0.25, and the initial value of market pessimism is set to -0.1. After the parameters are set, run the 1000 phase to get the simulation results as shown in Figure 19.

Figure 18. Evolution of asset price bubble and simulation of yields when the initial value of pessimism of single asset and market optimism is -0.25, 0.1, respectively

Figure 19. Evolution of asset price bubble and simulation of yields when the initial value of pessimism for single asset and market pessimism is -0.25, -0.1 respectively
By analyzing Figure 19, we can find that the asset price bubble is in a state of continuous generation, expansion, and rupture, and the fluctuation is between -4.93 and 2.72. The fluctuation of the bubble is greater than the pessimistic mood of the asset alone and the market pessimism. The asset price bubble is more in a negative bubble state; under the influence of the pessimistic sentiment of the single asset pessimistic market, the asset price and its fundamental value are in a decline state. Under the effect of the mutual promotion of two types of pessimism, asset prices fall faster, and this state has an adverse effect on assets.

5. Conclusions
This paper introduced the adjustment function of the parameters of single asset sentiment, market sentiment, herd behavior traders and mean reversion traders in the agricultural commodities futures market, and regarded the intrinsic value as change, so that the simulation of asset price bubble in the agricultural commodities futures market was closer to reality, and then simulated the time series of asset price bubbles under the change of single asset sentiment and market sentiment, finally the mechanism of single asset sentiment and market sentiment on the evolution of asset price bubble was revealed. The study found that in the agricultural commodities futures market the optimism of single asset sentiment and market sentiment, the asset price bubble gradually increased, and the asset price bubble showed in the agricultural commodities futures market a continuous expansion trend with the increase of simulation time. Meanwhile, the results also indicated that the evolution mechanism of asset price bubble from the perspective of single asset sentiment and market sentiment can analyze the real asset price operation process in the agricultural commodities futures market to a certain extent.

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