Research On the Impact of Aluminum Metal Futures Prices on The Stock Prices of Aluminum Enterprises- Based on The Perspective of Upstream and Downstream

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Abstract. This paper takes aluminum metal futures as an example to explore the impact of fluctuations in non-ferrous metal futures prices on the stock price performance of related listed companies. Firstly, the basic situation of aluminum futures is introduced, and then further discussion is conducted on how aluminum futures affect the stock prices of upstream and downstream enterprises related to aluminum. Then, empirical analysis is conducted. This article uses methods such as ADF, EG-ADF, ECM model, and Granger test to explore the impact of aluminum metal futures prices on the weighted stock prices of upstream and downstream enterprises related to aluminum. The research results indicate that the impact of aluminum metal futures prices on the stock prices of aluminum enterprises varies with different positions in the industry chain. There is a one-way guiding relationship for the weighted stock prices of upstream aluminum enterprises, while there is no leading and lagging guiding relationship for the weighted stock prices of downstream enterprises. Based on the upstream and downstream perspectives, this article selects four representative listed companies in the aluminum industry to weight their stock prices according to their market value ratios, and explores their relationship with aluminum futures prices. This study helps investors evaluate stock price trends and make wiser investment choices; Adjusting business plans and coordinating stock prices for aluminum enterprises has positive significance; At the same time, it helps regulatory authorities to gain a deeper understanding of market information and further understand the price discovery function of futures markets.

Keywords: aluminum futures, aluminum futures price, stock price, enterprises.

1. Overview Of Aluminum Mental Futures

1.1. The Role of Non ferrous Metal Futures Market

With the continuous development of the economy, futures have gradually become an important financial derivative product. In recent years, China's non-ferrous metal futures have further developed, and the futures market has also been continuously improved and matured. The non-ferrous metal futures market in China has become one of the commodity futures markets with high degree of marketization and internationalization, and good market function. (Wang Yanli, Fu Shuixing, Tian Jinchuan et al., 2021 [3]) The futures market has functions of price discovery, risk management, and resource allocation, playing an important role in stabilizing prices and maintaining the security of the industrial and supply chains (Yang Yi, 2023 [5]).

The non-ferrous metal futures market has played an important role at different levels: from a macro perspective, the non-ferrous metal futures market provides decision-making basis for macroeconomic regulation, and the government can further formulate relevant industrial policies by monitoring price fluctuations and trading in the futures market. From a meso perspective, the development and growth of the futures market directly support and promote the development of China's non-ferrous metal industry. From a micro perspective, China's large and medium-sized non-ferrous metal enterprises can use hedging in the futures market to avoid operational risks. This means that companies can lock in future prices through futures contracts, thereby reducing the risk of price fluctuations in raw material procurement and production processes.
1.2. Aluminum metal futures

1.2.1 Contract Content

<table>
<thead>
<tr>
<th>Table 1 Aluminum futures contract content</th>
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<tbody>
<tr>
<td><strong>Trading instrument</strong></td>
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<tr>
<td><strong>Transaction unit</strong></td>
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<td><strong>Quotation unit</strong></td>
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<td><strong>Minimum moving price</strong></td>
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<td><strong>Limit range</strong></td>
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<td><strong>Contract month</strong></td>
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<td><strong>Trading hours</strong></td>
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<td><strong>Last trading day</strong></td>
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<td><strong>Delivery date</strong></td>
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<td><strong>Delivery grade</strong></td>
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<td><strong>Delivery point</strong></td>
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<tr>
<td><strong>Minimum margin</strong></td>
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<tr>
<td><strong>Delivery mode</strong></td>
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<tr>
<td><strong>Delivery unit</strong></td>
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<tr>
<td><strong>Transaction code</strong></td>
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<td><strong>Listed exchange</strong></td>
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Note: Amended in accordance with Announcement [2023] No. 2 issued by the Shanghai Futures Exchange on January 17, 2023.

The trading of aluminum futures began in the early 1980s, primarily trading on the London Metal Exchange (LME). With the development of the market, the main aluminum futures trading markets now include LME, Chicago Mercantile Exchange (CME) in the United States, and Shanghai Futures Exchange (SHFE) in China. The specific details of the contract are shown in Table 1.

1.2.2 Development of Futures

![Figure 1](image-url) 2010-2023 aluminum futures volume of Shanghai Futures Exchange
From Figures 1 and 2, it can be seen that the trading volume and amount of aluminum futures have been increasing year by year in recent years, indicating that aluminum futures trading is becoming increasingly active and the aluminum futures market is constantly improving and developing. The existence of the aluminum futures market enables producers, consumers, and investors to manage future price fluctuations. Producers can lock in future sales prices by selling futures contracts, consumers can lock in future purchase prices by buying futures contracts, and investors can speculate on future price changes by buying and selling futures contracts. At the same time, the aluminum futures market also provides an important reference for the spot price of aluminum.

2. Theoretical Relationship Between Aluminum Metal Futures And Stock Prices Of Aluminum Enterprises

2.1. Influence stock prices through industrial policies

Aluminum futures further affect corporate stock prices through price fluctuations affecting industrial policies. The price of aluminum futures usually causes the government to re-evaluate and adjust macroeconomic and industrial policies. The government usually takes into account the signals of the futures market and the potential impact of futures prices on the real economy and society when taking action. Political investors usually pay close attention to changes in industrial policy, and adjust their investment portfolios according to the expectations of the future business and earnings of the enterprise to further affect the stock price of the enterprise, and this factor has the same impact on upstream and downstream enterprises in aluminum.

2.2. Influence stock price through spot price

There is a two-way guiding relationship between aluminum futures and spot prices, that is, there is a long-term stable relationship between futures and spot prices. (Qu Hongtao, Zhuang Xintian, Su Yanli et al. 2011[1]). Therefore, the aluminum futures price affects the profitability of aluminum enterprises by affecting the price of aluminum spot, further affecting investors' forecasts for the company, and ultimately affecting its stock price.

For listed companies, especially those that use spot non-ferrous metals as commodities, their performance is very sensitive to the price of related resources, and the change of spot price will endanger the profit margin of many related companies. The change of futures price reflects the change of supply and demand of spot commodities through the spot market, which affects the production cost or product selling price of upstream and downstream aluminum listed companies, affecting the production and operating performance of these listed companies, such as net profit, net asset profit margin. Through the analysis of the company's publicly disclosed statements, investors realize the fact that the company's performance changes, form the expectation of the listed company's stock price, and ultimately affect the stock price of the listed company in the stock exchange. Under this mechanism of action of futures, the position of the listed company in the supply chain determines how the company is affected.
In general, for enterprises upstream of the supply chain of the aluminum industry, the signal of rising futures prices will be transmitted to the spot market, causing the price of products of enterprises in the industry to change in the same direction. Without considering other factors, such signals are expected to improve the performance of upstream companies, which may lead to higher stock prices of listed companies. For enterprises downstream of the supply chain, rising futures prices lead to rising spot prices, even though production costs increase, which slows down the profitability of enterprises to a certain extent. This causes investors to expect its stock price to fall, if investors make investment decisions based on this, it may lead to the trend of lower stock prices of downstream listed companies.

3. Empirical test

3.1. Data Selection

3.1.1 Selection of futures price data

The aluminum futures settlement price of Shanghai Futures Exchange from January 5, 2009 to December 8, 2023 (continuous) is selected for the demonstration of aluminum futures prices and upstream enterprises’ weighted stock prices, with a total of 3569 data. The aluminum futures settlement price of Shanghai Futures Exchange from July 18, 2012 to December 8, 2023 (continuous) was selected for the empirical analysis of aluminum futures prices and weighted stock prices of downstream enterprises. A total of 2716 data were obtained from Flush iFinD.

3.1.2 Stock price data selection

The top 15 main businesses of listed aluminum enterprises in terms of total market value are sorted out according to the data of Flush, as shown in Table 2.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Main business of the top 15 enterprises in the total market value of aluminum industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking</td>
<td>Enterprise name</td>
</tr>
<tr>
<td>one</td>
<td>Aluminum Corporation Of China Limited</td>
</tr>
<tr>
<td>two</td>
<td>Yunnan Aluminium Co.,Ltd</td>
</tr>
<tr>
<td>three</td>
<td>SHANDONG NANSAN ALUMINIUM CO., LTD</td>
</tr>
<tr>
<td>four</td>
<td>Inner Mongolia Dian Tou Energy Corporation Limited</td>
</tr>
<tr>
<td>Rank</td>
<td>Company Name</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Tianshan Aluminum Group Co., Ltd</td>
</tr>
<tr>
<td>6</td>
<td>Innovation New Material Technology Co., Ltd.</td>
</tr>
<tr>
<td>7</td>
<td>Guangdong Hec Technology Holding Co., Ltd.</td>
</tr>
<tr>
<td>8</td>
<td>Shanghai Huafon Aluminium Corporation</td>
</tr>
<tr>
<td>9</td>
<td>Henan Zhongfu Industrial Co., Ltd</td>
</tr>
<tr>
<td>10</td>
<td>Henan Mingtai Al.Industrial Co., Ltd.</td>
</tr>
<tr>
<td>11</td>
<td>Jiangsu Dingsheng New Materials Joint-Stock Co., Ltd</td>
</tr>
<tr>
<td>12</td>
<td>Xinjiang Joinworld Co., Ltd.</td>
</tr>
<tr>
<td>13</td>
<td>Jiangsu Asia-Pacific Light Alloy Technology Co., Ltd</td>
</tr>
<tr>
<td>14</td>
<td>Jiaozuo Wanfang Aluminum Manufacturing Co., Ltd.</td>
</tr>
<tr>
<td>15</td>
<td>Yinbang Clad Material Co., Ltd.</td>
</tr>
</tbody>
</table>

According to the data in the above table, four listed companies with high market value and most influence in aluminum mining and smelting in the A stock market are selected: Aluminum of China, Cloud Aluminum Shares, Nanshan Aluminum, and Xinjiang Zhonghe. The downstream companies selected are three listed companies with greater influence in the A stock market engaged in aluminum-related deep processing: Zhongfu Industry, Mingtai Aluminum, Asia-Pacific Technology and Yinbang Shares. The upstream stock price data are also selected from 2009 to 2023, and the downstream stock price is selected from 2012 to 2023 due to incomplete data, and the final stock price results are calculated according to the weighted calculation of relative market value. Therefore, the weighted numbers of upstream enterprises are 49.5\%, 24.7\%, 20\% and 5.8\% respectively. The
weighted numbers of downstream enterprises were 32.5%, 32.3, 19.3 and 15.9, respectively. Data source: East Wealth Choice Data.

3.2. Empirical analysis of aluminum futures prices and upstream companies’ weighted stock prices

3.2.1 Stationarity test

Stationarity test is a necessary part of time series analysis, the purpose is to check whether the time series data has stable distribution characteristics, so as to carry out reasonable analysis and prediction. There are DF test, ADF test and PP test, among which ADF test is the most commonly used test method. (Fan Yawen, 2023[4]) Through the observation of the time series diagram of variables, this paper tested the original data with constant terms and trend terms, and tested the data after first-order difference without constant terms and trend terms. The maximum lag order of Schwert (1989) test is selected: \( p_{\text{max}} = 12 \times (T/100)^{1/4} \), where \( T \) is the sample size and stata is used for the test.

![Figure 3 qi stationarity test results](image1)

![Figure 4 D. qi stationarity test results.](image2)

![Figure 5 gus stationarity test results](image3)

![Figure 6 D.gus stationarity test results.](image4)

qi represents the aluminum futures price, dqi represents the first-order difference of aluminum futures price, gus represents the weighted share price of aluminum upstream enterprises, and dgus represents the first-order difference of the weighted share price of aluminum upstream enterprises.

According to the test results of the above figure, at the level of 5%, the aluminum futures price is a non-stationary time series data and stable after first-order difference. Similarly, at the 5% level, the weighted stock price of aluminum upstream enterprises is non-stationary time series data, stable after first-order difference.

3.2.2 Test of cointegration relationship

Next, the cointegration relationship between variables qi and gus is tested, in order to test whether there is a long-term equilibrium relationship between the two variables, provided that both variables are unit root variables. According to the co-integration theory, a certain linear relationship between two non-stationary variables may be stationary, that is, its residuals are stationary sequences, and there is a long-term equilibrium relationship between the two variables that changes cooperatively (Zhang Xiaodong, 2001[2]).

This paper is divided into two steps according to EG-ADF test. The specific steps are as follows: First, OLS is used to estimate the cointegration coefficient of the two variables, and then ADF test is performed on the residual sequence to determine whether it is stable. It can be seen from the above
analysis that both aluminum futures price and weighted stock price of aluminum upstream enterprises are first-order monointegrals, so the regression residual of the two is tested by ADF, and the test results are as follows.

![Figure 7](image1.png)

**Figure 7** Aluminum futures price and aluminum upstream enterprises weighted stock price regression results.

![Figure 8](image2.png)

**Figure 8** Test of co-integration relationship between aluminum futures price and weighted stock price of aluminum upstream enterprises.

As can be seen from the test results in Figure 8, there is a long-term equilibrium relationship between aluminum futures prices and the weighted stock prices of aluminum upstream enterprises at the 5% level, and according to the regression results in Figure 9, the long-term equilibrium formula between the two is $gus = 0.000354q_i + 1.341377$

3.2.3 Establishment of Error Correction Model (ECM)

The short-term equilibrium relationship between $q_i$ and $gus$ was further analyzed by error correction model (Zhang Yanfang, 2023[6]). In this paper, the formula is set as $dgus = \beta_0 + \beta_1 dgus_{\text{lag}} + \beta_2 dq_i + \lambda ecmt - 1 + \mu$, where $dgus_{\text{lag}}$ represents the lag term of $dgus$. The result after regression is shown in Figure 9.

![Figure 9](image3.png)

**Figure 9** Aluminum futures price and aluminum upstream enterprises weighted stock price error test model regression results.

According to the test results, at the 5% confidence level, $b_1$, $b_2$ and $\lambda$ are significant, and only the constant term is not significant. From the estimated value of coefficient 0.0012684, when the short-term fluctuation deviates from the long-term equilibrium, the unbalanced state will be pulled back to the equilibrium state with the adjustment force of 0.0012684.

3.2.4 Granger causality test

After the above analysis, it can be seen that there is a certain equilibrium relationship between aluminum futures price and the weighted stock price of aluminum upstream enterprises. Finally, Granger test is used to analyze the temporal causal relationship between aluminum futures price and the weighted stock price of aluminum upstream enterprises. Since both are non-stationary, we use their first-order differences as variables to test. According to the results in FIG. 10, we select a lag order of 2 for Granger test, and the test results are shown in FIG. 11.
Figure 10 Aluminum futures price and aluminum upstream enterprises weighted share price Granger test order selection results.

Figure 11 The Granger test results of aluminum futures price and aluminum upstream enterprises' weighted stock price.

According to the test results, when dgus is the explained variable, the p value is 0.019, so the null hypothesis that aluminum futures price is not the Granger cause of the weighted stock price of aluminum upstream enterprises is rejected. However, when dqi is the explained variable, the p value is 0.267. The original hypothesis that the weighted stock price of aluminum upstream enterprises is not the Granger cause of aluminum futures price is accepted. That is, the aluminum futures price does have a one-way guiding relationship with the weighted stock price of aluminum upstream enterprises.

3.3. Empirical analysis of aluminum futures price and weighted stock price of downstream enterprises

3.3.1 unit root test

The weighted stock price of aluminum downstream enterprises from July 18, 2012 to 2023.12.8 was named as variable gux, and the settlement price of aluminum futures during the same period was named qi2. D.uX and D.qi2 were first-order differences respectively, and ADF unit root test was conducted. The test results are shown in the figure below.
According to the test results, at the level of 5%, aluminum futures prices are non-stationary time series data and stable after first-order difference. Similarly, at the 5% level, the weighted stock price of aluminum downstream enterprises is non-stationary time series data and stable after first-order difference.

### 3.3.2 Co-integration relationship Test

Next, the co-integration relationship between aluminum futures price and the weighted stock price of aluminum downstream enterprises is tested. Test whether there is a long-term equilibrium relationship between them. EG-ADF method was also adopted to test the residual of regression between the two, and the test results were shown in Figure 16.

**Figure 16** Test results of co-integration relationship between aluminum futures price and weighted stock price of aluminum downstream enterprises.

As can be seen from the test results in Figure 16, there is a long-term equilibrium relationship between aluminum futures prices and weighted stock prices of aluminum downstream enterprises at the level of 5%.

### 3.3.3 Error correction model

The short-term equilibrium relationship between q12 and gux is further analyzed by the error correction model, and the formula is \( dgux = \beta_0 + \beta_1 dgux_{-1} + \beta_2 dq12 + \lambda \text{ecmt-1} + \mu \), where \( dgux_{-1} \) represents the lag term of \( dgux \). And regression is carried out, and the regression results are shown in Figure 17.

**Figure 17** Aluminum futures price and aluminum downstream enterprises weighted stock price error correction model regression.

According to the test results, at the 5% confidence level, \( b_1, b_2 \) and \( \lambda \) are significant, and only the constant term is not significant. From the coefficient estimate of -0.0041657, when the short-term fluctuation deviates from the long-term equilibrium, the disequilibrium state will be pulled back to the equilibrium state with the adjustment force of -0.0041657.

### 3.3.4 Granger causality test

Finally, Granger test is used to analyze the temporal causal relationship between aluminum futures price and weighted stock price of aluminum downstream enterprises. They are also tested using their first-order differences as variables. According to the results in FIG. 18, we select a lag order of 2 for Granger test, and the test results are shown in FIG. 19.

**Figure 18** Aluminum futures price and aluminum downstream enterprises weighted share price Granger test order selection.
4. Conclusion

Based on the above discussion and empirical analysis, the conclusion is summarized:

1. In recent years, the non-ferrous metal futures market has been developing continuously and its influence has been deepening. Aluminum futures trading is also more and more active, price discovery function is more and more mature. Theoretically, aluminum futures prices affect the stock prices of aluminum enterprises through the impact on industrial policies and corporate performance, and have different impacts on upstream and downstream enterprises.

2. Through the empirical analysis of aluminum futures prices and weighted stock prices of aluminum upstream enterprises, it can be found that both of them are non-stationary time series at the 5% level, and they are stable after first-order difference, that is, first-order monointegration. At the 5% confidence level, there is a cointegration relationship between aluminum futures prices and the weighted stock prices of aluminum upstream enterprises, and the long-term equilibrium expression is, indicating that there is a positive correlation between the two.

3. It is found that when the short-term fluctuation deviates from the long-term equilibrium, the disequilibrium state will be pulled back to the equilibrium state with the adjustment force. After that, the lag order is selected as 2 to conduct Granger test on the first-order difference components of the two, and it is further found that aluminum futures price does have a one-way guiding relationship with the weighted stock price of aluminum upstream enterprises.

Through the ADF test of aluminum futures price and weighted stock price of aluminum downstream enterprises, it is found that both are non-stationary time series, which is stable after first-order difference, that is, first-order single integer. At the confidence level of 5%, there is a cointegration relationship between aluminum futures price and the weighted stock price of aluminum downstream enterprises.

4. It is found that when the short-term fluctuation deviates from the long-term equilibrium, the disequilibrium state will be pulled back to the equilibrium state with the adjustment force. However, after Granger test, it is found that there is no guiding relationship in time sequence between the two, and the conclusion remains unchanged after multiple tests of other orders, indicating that although there is a co-integration relationship between the two, aluminum futures prices have no leading and lagging guiding relationship with the stock prices of downstream deep processing enterprises, so further research is still needed.

5. Through the empirical comparison of aluminum futures prices on the weighted stock prices of aluminum upstream enterprises and aluminum downstream enterprises, the influence of aluminum futures prices on the stock prices of aluminum enterprises varies with different positions in the industrial chain. It can be seen that aluminum futures prices have a one-way guiding relationship with the weighted stock prices of aluminum upstream enterprises, while there is no leading and lagging guiding relationship with the weighted stock prices of downstream enterprises.
References


