## SMM Quantitative Trading Strategy

<table>
<thead>
<tr>
<th>Contract</th>
<th>Arbitrage Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHFE Copper</td>
<td>Inter-Commodity</td>
</tr>
<tr>
<td>SHFE Aluminum</td>
<td>None</td>
</tr>
<tr>
<td>SHFE Lead</td>
<td>None</td>
</tr>
<tr>
<td>SHFE Zinc</td>
<td>Inter-Commodity</td>
</tr>
<tr>
<td>SHFE Nickel</td>
<td>Inter-Commodity</td>
</tr>
<tr>
<td>SHFE Steel Rebar</td>
<td>Calendar</td>
</tr>
<tr>
<td>SHFE Hot-rolled coil</td>
<td>None</td>
</tr>
<tr>
<td>DCE Iron Ore</td>
<td>None</td>
</tr>
</tbody>
</table>

**Source:** SHFE, SMM

**Methodology:**

In this report, we use the statistical arbitrage strategy to find the historically correlated underlying assets, the profitability of pairs trading is selected by using the co-integration method in China’s commodity market over the period of 2017 to 2018.

**Co-integration Matrix**

**Correlation Matrix:**

![Co-integration Matrix](image1)

![Correlation Matrix](image2)

**Source:** SMM

**Note:** Deeper colors indicate higher correlation/co-integration
After applying the unit root test (in this case, the ADF method is applied) to identify the feasibility of the potential trading pairs, we choose the high-correlated pairs ($p > 0.80$) as follows:

**Table1: Selected Correlation Matrix**

<table>
<thead>
<tr>
<th></th>
<th>CU</th>
<th>ZN</th>
<th>NI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CU</td>
<td>1.0000</td>
<td>0.9375</td>
<td>0.8710</td>
</tr>
<tr>
<td>ZN</td>
<td>0.9375</td>
<td>1.0000</td>
<td>0.8579</td>
</tr>
<tr>
<td>NI</td>
<td>0.8710</td>
<td>0.8579</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Source: SMM

We use linear regression to determine the integration equation (in Ton). After standardizing the residuals series, we determine the long/short position of each portfolio as follows:

**Table2: Trading Pairs**

<table>
<thead>
<tr>
<th>Contract</th>
<th>Trading Pair</th>
<th>Portfolio</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHFE Copper</td>
<td>SHFE Zinc</td>
<td>4<em>CU1804-7</em>ZN1804</td>
<td>Long</td>
</tr>
<tr>
<td>SHFE Zinc</td>
<td>SHFE Nickel</td>
<td>4*ZN1804-Ni1805</td>
<td>Short</td>
</tr>
</tbody>
</table>

Source: SMM

For calendar arbitrage, we standardized the historical spread of the corresponding portfolio from 01/10/2017 to now to determine the long/short position:

**Table3: Trading Pairs**

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Arbitrage Type</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB1805-RB1810</td>
<td>Calendar Arbitrage</td>
<td>Long</td>
</tr>
</tbody>
</table>

Source: SMM
SHFE Copper pair trading analysis

4*CU1804-7*ZN1804

1. SHFE Close Price (CNY/Ton)

2. Residual Series

Dash line: Current z-score by 23/02/2018

Source: SHFE, SMM

Statistical arbitrage analysis: By 23/02/2018, the standardized residual of the corresponding portfolio 4*CU1804 - 7*ZN1804 is -0.72 which is lower than 75% of the sample observed. Thus, SMM forecasts that the spread would revert to the previous mean.

Recommended strategy: Taking the long position of the portfolio, close position when the standardized residual close to zero.
SHFE Zinc pair trading analysis

4•ZN1804-NI1805

1. SHFE Close Price (CNY/Ton)

2. Residual Series

3. Histogram

Zscore Analysis

Dash line: Current z-score by 23/02/2018
Source: SHFE, SMM

Statistical arbitrage analysis: By 23/02/2018, the standardized residual of the corresponding portfolio 4•ZN1804-NI1805 is 1.54, which is higher than 93% of the sample observed. Thus, SMM forecasts that the spread would revert to the previous mean.

Recommended strategy: Taking the short position of the portfolio, close position when the standardized residual close to zero.
SHFE RB spread trading analysis

RB1805-RB1810

1. SHFE Close Price (CNY/Ton)

2. Residual Series

3. Histogram

Dash line: Current z-score by 23/02/2018
Source: SHFE, SMM

Statistical arbitrage analysis: By 23/02/2018, the standardized residual of the corresponding portfolio RB1805-RB1810 is -1.70, which is lower than 98% of the sample observed. Thus, SMM forecasts that the spread would revert to the previous mean.

Recommended strategy: Taking the long position of the portfolio, close position when the standardized residual close to zero.
The information contained in this report is only as current as of the date indicated, and may be superseded by subsequent market events or for other reasons. Neither the author nor SMM undertakes to advise you of any changes in the views expressed herein.

The views and opinions expressed in this report are not related to any specific trading strategy that SMM offers. It is being provided merely to provide a framework to assist in the implementation of an investor’s own analysis and investor’s own view on the topic discussed herein.

Past performance is no guarantee of future results.

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