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>None</td>
</tr>
<tr>
<td>SHFE Steel Rebar</td>
<td>Inter-Commodity</td>
</tr>
<tr>
<td>SHFE Hot-rolled coil</td>
<td>Inter-Commodity</td>
</tr>
<tr>
<td>DCE Iron Ore</td>
<td>None</td>
</tr>
</tbody>
</table>

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:

*Remarks:* 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 highly correlated pairs ($\rho > 0.80$) as follows:

**Table 1: Selected Correlation Matrix**

<table>
<thead>
<tr>
<th></th>
<th>CU</th>
<th>HC</th>
<th>RB</th>
<th>ZN</th>
</tr>
</thead>
<tbody>
<tr>
<td>CU</td>
<td>1.0000</td>
<td>0.8657</td>
<td>0.8460</td>
<td>0.9373</td>
</tr>
<tr>
<td>HC</td>
<td>0.8657</td>
<td>1.0000</td>
<td>0.9374</td>
<td>0.8887</td>
</tr>
<tr>
<td>RB</td>
<td>0.8460</td>
<td>0.9374</td>
<td>1.0000</td>
<td>0.8623</td>
</tr>
<tr>
<td>ZN</td>
<td>0.9373</td>
<td>0.8887</td>
<td>0.8623</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

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:

**Table 2: 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>5<em>CU1803-9</em>ZN1803</td>
<td>Short</td>
</tr>
<tr>
<td></td>
<td>SHFE Hot-rolled coil</td>
<td>2<em>CU1803-15</em>HC1805</td>
<td>Short</td>
</tr>
<tr>
<td>SHFE Zinc</td>
<td>SHFE Steel Rebar</td>
<td>CU1803-8*RB1805</td>
<td>Short</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>SHFE Steel Rebar</td>
<td>ZN1803-4*RB1803</td>
<td>Short</td>
<td></td>
</tr>
<tr>
<td>SHFE Hot-rolled coil</td>
<td>4<em>ZN1803-15</em>HC1805</td>
<td>Short</td>
<td></td>
</tr>
</tbody>
</table>
SHFE Copper pair trading analysis

5*CU1803-9*ZN1803:

1. SHFE Close Price

2. Residual Series

Source: SHFE
Statistical arbitrage analysis: by 11/01/2018, the standardize residual of the corresponding portfolio 5*CU1803-9*ZN1803 is 0.97, which is higher than 83% of the sample observed. Thus, SMM forecast 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.
2*CU1803-15*HC1805

1. SHFE Close Price

2. Residual Series

Source: SHFE
Statistical arbitrage analysis: by 11/01/2018, the standardize residual of the corresponding portfolio $2 \times \text{CU1803} - 15 \times \text{HC1805}$ is 2.22, which is higher than 97% of the sample observed. Thus, SMM forecast 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.
**CU1803-8*RB1805**

1. **SHFE Close Price**

![CU1803 Close price - LHS](chart)

Source: SHFE

2. **Residual Series**

![Residual Series](chart)
Statistical arbitrage analysis: by 11/01/2018, the standardize residual of the corresponding portfolio CU1803-7*RB1805 is 2.4, which is higher than 90% of the sample observed. Thus, SMM forecast 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 Zinc pair trading analysis

ZN1803-4*RB805

1. SHFE Close Price

Source: SHFE

2. Residual Series

Source: SHFE, SMM
3. Histogram

Dash line: Current z-score by 11/01/2018
Source: SMM

Statistical arbitrage analysis: by 11/01/2018, the standardize residual of the corresponding portfolio ZN1803-4*RB1805 is 1.28, which is higher than 88% of the sample observed. **Thus, SMM forecast 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.
4*ZN1803-15*HC1805:

1. SHFE Close Price

![SHFE Close Price Chart](chart1.png)

Source: SHFE

2. Residual Series

![Residual Series Chart](chart2.png)

Source: SHFE, SMM
3. Histogram

Dash line: Current z-score by 11/01/2018
Source: SMM

Statistical arbitrage analysis: by 11/01/2018, the standardize residual of the corresponding portfolio 4*ZN1803-15*HC1805 is 1.94, which is higher than 97% of the sample observed. Thus, SMM forecast 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.
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.