Stress Indicator Pairs Trading Strategy: Analysis of Methanol-Ethylene Glycol Futures

Research Report

November 14, 2025

Abstract

This research report analyzes the performance of a strategy based on the Stress Indicator from *Trading Systems and Methods, Chapter 13*. The strategy is a statistical arbitrage approach that constructs a stress indicator using the difference between stochastic oscillators of two assets as entry and exit signals for pairs trading. The analysis focuses on the pair of Methanol continuous contract (R.CN.CZC.MA.0004) and Ethylene Glycol continuous contract (R.CN.DCE.eg.0004) using daily data. The strategy employs a bidirectional position opening mechanism.

1 Paired Assets and Logic

1.1 Asset Selection

This research examines the pairing of Ethylene Glycol and Methanol futures contracts.

1.2 Pairing Rationale

1.2.1 Market Characteristics

1. **Similar Physical and Chemical Properties**: Both are liquids, both belong to the alcohol chemical category, both appear colorless and transparent, and both are toxic.

2. **Consistent Market Attributes**: Both have relatively high import dependency, and both rely primarily on tank storage and tanker transportation for warehousing and logistics.

3. **Similar Driving Factors**: On the supply side, methanol prices are driven by coal and natural gas prices, while ethylene glycol prices are driven by crude oil and coal prices. On the demand side, as both serve downstream manufacturing industries, prices are highly influenced by economic cycles.

1.2.2 Statistical Correlation

In this analysis, we selected methanol and ethylene glycol futures data, aligned their closing prices to retain only trading days where both assets had available prices, and calculated the correlation coefficient between the two price series.

Results show a high correlation coefficient of 0.87 between methanol and ethylene glycol closing prices, indicating highly synchronized price movements. Visual inspection of the price curves confirms that both time series fluctuate in near-perfect synchronization. Therefore, we conclude that these two futures contracts exhibit strong linear correlation, making them suitable candidates for pairs trading strategies and warranting further research in spread trading applications.

2 Trading Strategy Framework

2.1 Indicator Definition

The Stress Indicator, proposed by Perry Kaufman, is a technical indicator designed for pairs trading. Its core concept involves using a "triple stochastic" calculation process to measure the extremity of the relative strength relationship between two correlated assets.

Unlike directly using the difference between two stochastic oscillators, the Stress Indicator applies the stochastic calculation again to this difference, thereby standardizing it into an oscillator that fluctuates between 0 and 100. This approach provides a unified and clear framework for identifying overbought and oversold regions, making trading signal identification simpler and more reliable.

2.2 Calculation Methodology

The Stress Indicator calculation consists of three main steps:

2.2.1 Step 1: Calculate Individual Asset Stochastic Oscillators

First, calculate the raw stochastic oscillator for each of the two paired assets (e.g., Asset 1 and Asset 2) over a period of n days.

Stochastic for Asset 1:

$$\text{Stochastic1}_t = \frac{C1_t - \min_{i=t-n,t-1}(L1_i)}{\max_{i=t-n,t-1}(H1_i) - \min_{i=t-n,t-1}(L1_i)} \times 100 \tag{1}$$

Stochastic for Asset 2:

$$\text{Stochastic2}_t = \frac{C2_t - \min_{i=t-n,t-1}(L2_i)}{\max_{i=t-n,t-1}(H2_i) - \min_{i=t-n,t-1}(L2_i)} \times 100 \tag{2}$$

Symbol	Meaning
$C1_t, C2_t$	Closing prices of Assets 1 and 2 at time t
$L1_i, L2_i$	Lowest prices of Assets 1 and 2 over past n periods
$H1_i, H2_i$	Highest prices of Assets 1 and 2 over past n periods
n	Calculation period (e.g., 14 days)

Indicator Interpretation: This formula measures where the current closing price sits within its n-period price range. Multiplied by 100, the value ranges from 0 to 100. Higher values indicate the closing price is near recent highs, representing stronger momentum for the asset.

2.2.2 Step 2: Calculate the Difference Between Stochastic Oscillators

Next, calculate the difference between the two stochastic oscillators obtained in Step 1, creating a new time series D_t:

$$D_t = \text{Stochastic1}_t - \text{Stochastic2}_t \tag{3}$$

Indicator Interpretation:

- D_t directly reflects the relative strength between the two assets at the same time point.
- $D_t > 0$: Asset 1 is stronger than Asset 2 (its closing price is closer to its recent high).
- $D_t < 0$: Asset 2 is stronger than Asset 1.

While this difference can be used for trading, its fluctuation range is not fixed, making it difficult to establish uniform thresholds.

2.2.3 Step 3: Apply Stochastic Calculation to the Difference Series

This is the critical step. We treat the difference series D_t obtained in Step 2 as a new "price" and apply the stochastic oscillator formula again, using the same period n:

$$\text{Stress}_t = \frac{D_t - \min_{i=t-n}^{t-1}(D_i)}{\max_{i=t-n}^{t-1}(D_i) - \min_{i=t-n}^{t-1}(D_i)} \times 100 \tag{4}$$

Symbol	Meaning
D_t	Current difference between the two stochastic oscillators
$\min_{i=t-n}^{t-1}(D_i)$	Minimum value of difference D over past n periods
$\max_{i=t-n}^{t-1}(D_i)$	Maximum value of difference D over past n periods

Indicator Interpretation: The final Stress_t measures where the current relative strength difference between the two assets sits within its own recent fluctuation range.

- Stress_t approaching 100: The current strength of Asset 1 relative to Asset 2 has reached an extreme level in the recent period.
- Stress_t approaching 0: The current weakness of Asset 1 relative to Asset 2 has reached an extreme level in the recent period.

2.3 Entry Timing

When $\text{Stress}_t > 95$ or $\text{Stress}_t < 5$, we consider the divergence between Assets 1 and 2 to have reached an extreme level with mean reversion tendency, triggering an entry signal.

2.4 Exit Timing

2.4.1 Exit for Entries When $\text{Stress}_t > 95$

Close position when Stress_t falls back to 60.

2.4.2 Exit for Entries When $\text{Stress}_t < 5$

Close position when Stress_t rises back to 40.

2.5 Position Sizing

The key to successful pairs trading is equalizing the risk of both assets. Otherwise, the entire trade's profit and loss will be determined entirely by the higher-risk (higher-volatility) asset, defeating the purpose of pair hedging.

Here we use the Equal Risk Exposure method based on Average True Range (ATR) to achieve risk equality.

2.5.1 Step 1: Calculate True Range (TR) for Individual Assets

First, calculate the True Range (TR) for each of the two paired assets. TR measures the most complete price fluctuation range within a trading period, particularly accounting for price gaps.

TR Calculation Formula:

$$TR_t = \max(H_t - L_t, |H_t - C_{t-1}|, |L_t - C_{t-1}|) \tag{5}$$

Symbol	**Meaning**
H_t	Current period's highest price
L_t	Current period's lowest price
C_{t-1}	Previous period's closing price

Indicator Interpretation: True Range (TR) is the maximum of three values:

1. Difference between current high and low
2. Absolute value of difference between current high and previous close
3. Absolute value of difference between current low and previous close

By comparing these three values, TR captures volatility ranges caused by price gaps that are not visible within the daily candlestick, thus more accurately reflecting market volatility.

2.5.2 Step 2: Calculate Average True Range (ATR)

Next, we smooth the TR series calculated in Step 1 to obtain the Average True Range (ATR) over period n.

ATR calculation involves two steps:

1. **Calculate Initial ATR**: The first ATR value is the simple arithmetic average of the first n TR values:
$$ATR_n = \frac{1}{n}\sum_{i=1}^{n} TR_i \tag{6}$$

2. **Calculate Subsequent ATR Values (Wilder's Smoothing Method)**: From period $n+1$ onwards, use the following recursive formula:

$$ATR_t = \frac{(ATR_{t-1} \times (n-1)) + TR_t}{n} \tag{7}$$

Symbol	Meaning
ATR_t	Current period's Average True Range
ATR_{t-1}	Previous period's Average True Range
TR_t	Current period's True Range
n	Calculation period

Indicator Interpretation: ATR reflects the average daily price fluctuation of an asset over the past n periods. It is a standardized measure of volatility.

2.5.3 Step 3: Calculate Equal-Risk Position Size

This is the critical step. We use ATR to calculate position sizes that equalize risk exposure for both legs.

Calculation Formula:

$$\text{Position Size} = \frac{\text{Fixed Risk Amount}}{ATR \times \text{Contract Multiplier}} \tag{8}$$

Symbol	Meaning
Fixed Risk Amount	Fixed risk amount per leg. A preset nominal risk exposure you're willing to bear on a single leg, e.g., ¥10,000
ATR	n-day Average True Range calculated in Step 2
Contract Multiplier	For futures, this converts price fluctuations to monetary value

Indicator Interpretation: This formula calculates position sizes that make the nominal daily profit/loss volatility approximately equal for assets with different volatilities. For a highly volatile asset, we trade smaller positions; for a stable asset, we trade larger positions, ultimately making Position Size × Average Daily Volatility roughly consistent.

For Fixed Risk Amount: Using Risk Multiplier

We can introduce a "risk multiplier" to adjust the Fixed Risk Amount setting.

Formula:

$$\text{Fixed Risk Amount}_{\text{pairs}} = \text{Fixed Risk Amount}_{\text{single}} \times \text{Risk Multiplier} \tag{9}$$

Risk Multiplier Selection: The risk multiplier depends on the correlation between the two legs. Higher correlation means better hedging effect, allowing a larger multiplier. Since we calculated a high correlation of 0.87 between methanol and ethylene glycol, we can use a risk multiplier of 3x-5x.

2.6 Risk Control

2.6.1 Time Stop

Time stop calculation involves two main steps: determining the stop period and comparing it with current holding time.

1. Calculate Time Stop Period

$$\text{Time Stop Period} = \text{window} \times \text{Time Multiplier} \tag{10}$$

Symbol	Meaning
Time Stop Period	Maximum number of days allowed for holding
window	Lookback period used in Stress Indicator calculation (e.g., 14 days)
Time Multiplier	Preset coefficient, typically 2 to 3

Indicator Interpretation: This formula establishes an objective "deadline" based on the strategy's observation period (window), giving it 2-3 times the grace period for the trading logic to materialize.

2. Trigger Condition

$$\text{Holding Period} \geq \text{Time Stop Period} \tag{11}$$

Trigger Logic: At the end of each trading day, check the current position's holding period. Once the holding period reaches or exceeds the calculated time stop period, trigger the time stop and force liquidation at the next trading day's opening.

2.6.2 Loss Stop

Loss stop calculation also involves two steps: determining the loss threshold and real-time calculation of current floating loss for comparison.

1. Calculate Loss Stop Threshold

$$\text{Loss Stop Threshold} = \text{Fixed Risk Amount} \times \text{Loss Multiplier} \tag{12}$$

Symbol	Meaning
Loss Stop Threshold	Monetary threshold for loss stop
Fixed Risk Amount	Nominal risk exposure set for single leg (after amplification)
Loss Multiplier	Preset coefficient, typically 2 to 3

Indicator Interpretation: This formula establishes a financial "last line of defense" based on the risk unit allocated for a single trade (Fixed Risk Amount), allowing 2-3 times extreme loss space to handle "black swan" events.

2. Calculate Current Floating P&L

$$\text{Floating PnL} = \text{PnL}_{\text{leg1}} + \text{PnL}_{\text{leg2}} \tag{13}$$

where each leg's P&L is calculated as:

$$\text{PnL}_{\text{leg}} = (\text{Current Price} - \text{Entry Price}) \times \text{Position Size} \times \text{Contract Multiplier} \times \text{Direction} \tag{14}$$

Symbol	Meaning
Floating PnL	Total floating P&L of the entire pair position
Current Price	Latest market price
Entry Price	Entry price when position was opened
Position Size	Number of contracts held
Contract Multiplier	Futures contract multiplier (1 for stocks)
Direction	Position direction: +1 for long, -1 for short

3. Trigger Condition

$$\text{Floating PnL} \leq -|\text{Loss Stop Threshold}| \tag{15}$$

Trigger Logic: Monitor the total floating P&L of the entire pair position in real-time. Once the floating loss reaches or exceeds the preset loss threshold, immediately trigger the loss stop and force liquidation with market orders.

2.7 Strategy Core Philosophy

The essence of the Stress Indicator strategy is a statistical arbitrage approach. It does not predict the absolute direction of the market (up or down), but focuses on identifying temporary imbalances in the relative relationship between two correlated assets and profiting from the mean reversion process of such imbalances.

3 Strategy Performance

3.1 Indicator Implementation

3.1.1 Basic Parameters

```
var window = 14;              // Stress Indicator calculation period
var atrWindow = 20;           // ATR calculation period
```

3.1.2 Entry and Exit Thresholds

```
var enterThreshold1 = 95;     // Scenario 1 entry: Stress >= 95
var enterThreshold2 = 5;      // Scenario 2 entry: Stress <= 5
var exitThreshold1 = 60;      // Scenario 1 exit: Stress <= 60
var exitThreshold2 = 40;      // Scenario 2 exit: Stress >= 40
```

3.1.3 Risk Management Parameters

```
var accountCapital = 500000;  // Total account capital
var riskPercentage = 0.02;    // Single-direction risk preference (2%)
var riskMultiplier = 3;       // Pairs trading risk multiplier
var timeMultiplier = 2;       // Time stop multiplier
var lossMultiplier = 2;       // Loss stop multiplier
```

3.1.4 Core Calculations

```
var stoch1 = (close1 - Lowest(low1, window)) /
             (Highest(high1, window) - Lowest(low1, window)) * 100;
var stoch2 = (close2 - Lowest(low2, window)) /
             (Highest(high2, window) - Lowest(low2, window)) * 100;
var diff = stoch1 - stoch2;
var stress = (diff - Lowest(diff, window)) /
             (Highest(diff, window) - Lowest(diff, window)) * 100;

var atr1 = ATR(high1, low1, close1, atrWindow);
var atr2 = ATR(high2, low2, close2, atrWindow);
var baseRiskAmount = accountCapital * riskPercentage;
var fixedRiskAmount = baseRiskAmount * riskMultiplier;
var multiplier1 = 10;
var multiplier2 = 10;
var positionSize1 = Math.floor(fixedRiskAmount / (atr1 * multiplier1));
var positionSize2 = Math.floor(fixedRiskAmount / (atr2 * multiplier2));

var enterSignal1 = (stress >= enterThreshold1);
    // Scenario 1: Short Asset 1, Long Asset 2
var enterSignal2 = (stress <= enterThreshold2);
    // Scenario 2: Long Asset 1, Short Asset 2

var exitSignal1 = (position == 'SHORT_1_LONG_2' && stress <= exitThreshold1);
var exitSignal2 = (position == 'LONG_1_SHORT_2' && stress >= exitThreshold2);
var exitSignal = exitSignal1 || exitSignal2;

var timeStopPeriod = window * timeMultiplier;
var holdingPeriod = CurrentBar - entryBar;
var timeStopSignal = (holdingPeriod >= timeStopPeriod);

var lossStopThreshold = fixedRiskAmount * lossMultiplier;
var pnlLeg1 = (close1 - entryPrice1) * positionSize1 *
              multiplier1 * direction1;
var pnlLeg2 = (close2 - entryPrice2) * positionSize2 *
              multiplier2 * direction2;
var floatingPnL = pnlLeg1 + pnlLeg2;
var lossStopSignal = (floatingPnL <= -Math.abs(lossStopThreshold));

var stopLossTriggered = timeStopSignal || lossStopSignal;
```

Metric	Value
Annual Return	3.48%
Cumulative Return	12.71%
Standard Deviation	0.2273
Sharpe Ratio	0.2698
Calmar Ratio	0.1495
Maximum Drawdown	-23.28%

Table 1: Strategy Performance Summary

3.2 Performance Metrics

3.3 Performance Analysis

3.3.1 Equity Curve Analysis

The equity curve chart is divided into two parts. The upper section shows the trend of account equity. The blue solid line represents total equity (including floating P&L), growing from an initial 1 million CNY to approximately 1.127 million CNY, achieving a total return of 12.71%. The orange dashed line represents cash balance (realized P&L only). The lower section's red curve shows drawdown, representing the decline in equity from its historical peak. The maximum drawdown of -23.28% occurred primarily during the 2020 pandemic period. While this drawdown level represents medium-to-high risk, the strategy successfully recovered and reached new highs in 2021, demonstrating good resilience. Overall, the strategy exhibits robust profitability, though investors should be prepared to tolerate approximately 25% drawdowns.

3.3.2 Trading Logic Visualization

The trading logic chart displays price movements and indicator behavior. The upper section shows price trends for MA (Methanol) and EG (Ethylene Glycol), while the lower section displays the Stress indicator curve. The Stress indicator measures the relative strength of the spread, ranging from 0 to 100. When the indicator crosses above 95 or below 5 (dashed lines), indicating extreme spread levels, the strategy enters positions (green vertical lines); when the indicator reverts to 60 or 40 (dotted lines), indicating spread normalization, the strategy exits positions (red vertical lines). The chart clearly shows that after most entry signals, the Stress indicator reverts toward the neutral zone, validating the effectiveness of the mean reversion logic. The strategy follows the principle of "extreme entry, reversion exit" with clear and definitive trading signals.

3.3.3 Position Duration Analysis

This chart visually displays the holding period of each trade through orange semi-transparent regions. The blue curve represents MA price movement, with each orange region representing a complete pairs trade. The region's starting point marks the opening time, the endpoint marks the closing time, and the width represents the holding period in days. The chart reveals that the strategy's trading frequency exhibits cyclical variation, with dense trading activity in certain periods and extended observation periods in others. Most orange regions are narrow, indicating this is primarily a short-term strategy with an average holding period of only 4 days. This short holding characteristic helps reduce capital occupation time and overnight risk. The chart demonstrates that the strategy employs strict filtering mechanisms, entering only when high-probability opportunities arise, avoiding overtrading.

4 Conclusion

The strategy employs a 14-day window for Stress indicator calculation, entering at extreme values (> 95 or < 5) and exiting in neutral zones (60/40), with risk controlled through ATR-based equal-risk position sizing and dual stop-loss mechanisms. Backtesting results show the strategy grew from an initial 1 million CNY to 1.127 million CNY, achieving a total return of 12.71% and annualized return of 3.48%. The strategy completed 70 trades with a win rate of 58.6% and an average holding period of only 4 days, reflecting its short-term trading characteristics. The maximum drawdown of -23.28%, occurring primarily during the 2020 pandemic period, represents medium-to-high risk levels. Despite experiencing significant drawdown, the strategy successfully recovered and reached new highs in 2021, validating both the effectiveness of the mean reversion logic and the strategy's resilience. Overall, the strategy achieves stable positive returns in highly correlated pairs through strict filtering mechanisms and risk controls.