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The results presented may include historical simulations (backtests) and may not reflect all execution costs and constraints (including commissions, spreads, slippage, taxes, and liquidity limitations). Historical or simulated performance is not a guarantee of achieving similar results in the future.

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The results shown in the reports are indicative only and depend on the adopted methodology, data selection, parameters, assumptions, and the way risk and return measures are calculated. Actual results may differ materially from historical or simulated results.

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Methodology

TradingEdge.Pro's methodology describes a multi-step process for building and validating trading strategies, structured into two parts: strategy development and testing, and practical use. In the testing phase, a strategy is defined as a set of objective rules, validated through initial tests, optimised, and assessed for stability (robustness), and then evaluated using Walk-Forward Analysis. The detailed testing assumptions (including the instrument universe, in-sample/out-of-sample periods, data sources, transaction costs, and execution rules) are described in the "Testing Specification" document. The full methodology and metric definitions are available on the TradingEdge.Pro "Methodology" page.

Vol Trade v.3

Investment Strategy Testing Summary

Vol Trade v.3 strategy is a swing trading technique based on **volatility contraction** and **range expansion** in the direction of the prevailing trend. In the long version, it combines **a trend filter** (close above the long-term moving average) with the condition that **short-term volatility** falls to **a fraction of long-term volatility. After such a period of low volatility, a strong bullish candle** generates a signal, simultaneously setting **a new local high.**

The strategy **uses stop-loss orders based on a multi-day local low that follows the market –** this is the only difference compared to version v.2, which addresses the need for better risk control. Exit occurs when **short-term volatility exceeds long-term volatility** (a shift in the volatility regime) or a defensive order is triggered.

It's worth noting that while the strategy's results on in-sample data are decent, it failed stability testing across a wide range of optimized parameters. This means the strategy loses its profitability and generates significantly larger drawdowns when tested with suboptimal parameters. Therefore, **it is not recommended for use in real-world trading.**

Our goal is to have a strategy that remains **profitable and effective across a wide range of parameters,** because the market is a volatile organism, and optimal parameters can change over time. **I can't** emphasize enough that for **a strategy to work** in real-world conditions, it must also perform under **suboptimal parameters** and **conditions.** In short, **it must be stable** to changing market conditions.

I don't know who said these words, but they perfectly capture the problem of many optimizations:

"I've never seen a strategy that didn't work in backtests."

We don't know the future, we don't know future market conditions, but if we know that our strategy **has historically generated acceptable results** in various market conditions and across various parameter ranges, then we are **one step ahead of other** market participants.

Contents

Step 1: Formulate an investment strategy

Vol Trade v.3 strategy joins **an ongoing trend** when the market transitions from **a low-volatility regime** to **an impulse.** The trend context is confirmed by **the long-term moving average** – long positions are only considered when the price closes **above** this average. The preparatory condition is **a decline in short-term volatility below the long-term.** The confirmation of the breakout is a candle, which establishes **a new local extreme** and closes in the direction of the prevailing trend. The entry is executed **at the opening of the following day,** while the defensive **stop loss order is based on a multi-day local low that follows the market.**

Exiting the position occurs **only** when **the volatility regime changes** – **short-term volatility above long term.**

The strategy uses:

- **Trend Filter (SMA Long)** – selection of direction according to the dominant movement;
- **Variation ratio** – VolShort/VolLong ≤ threshold;
- **Extreme** – the signal candle is in line with the dominant trend and establishes a local high;
- **Entry T+1** – opening a position at the start of the next session;
- **Defensive stop loss order** – based on a local low of several days that follows the market;
- **Regime Change Reach** – close when short-term volatility ≥ long-term volatility.

Characteristics – strengths and weaknesses:

- **Quantitative, simple rules** (trend, contraction, breakout) – facilitate automation and testing;
- **Entry after confirmation –** reducing "false starts" typical of catching traffic early;
- **Lack of stop loss increases the risk of drawdowns and gaps** – strict control of position size is necessary;
- **Sensitivity to the definition of variability** – parameter sensitivity analysis recommended.

Vol Trade v.3 strategy, while simple, provides **a solid foundation for building algorithmic portfolios.** However, it requires **discipline and strict adherence to risk management methods.**

Step 2: Determine investment principles

Below is **the pseudocode** for the **Vol Trade v.3 strategy** on daily data:

1. **Calculating Indicators:**
    a. **XXX-MALong –** XXX day moving average closing price.
    b. **XXX-VolLong** – XXX day variability (sum of squared deviations).
    c. **YY-VolShort** – YY day variability (sum of squared deviations).
    d. **WW-VolRatio** – VolShort/VolLong variability ratio below WW%.
    e. **YY-HighestHigh** – YY daily highest high.
    f. **YY-LowestLow** – YY daily lowest low.
2. **Generating Entry Signals – Long Position:**
    a. **Trend:** closing price above MALong.
    b. **Volatility contraction:** VolShort/VolLong below WW%.
    c. **Extreme:** Today's high is the highest high in YY days (HighestHigh) and today's candle is bullish.
    d. **Entry:** Once the conditions are met, a long position is opened at the opening of the next session.
    e. **Stop loss:** We set a defensive stop loss order at the YY level of the day's lowest low, which then follows the market.
3. **Generating Output Signals:**
    a. **Volatility regime change:** close all positions at the opening of the next session when VolShort > VolLong.
    b. **Stop Loss Activation:** Close all positions when the price activates a defensive stop loss order.
4. **Daily Monitoring:**
    a. Every day calculate MALong, VolShort, VolLong, VolRatio, HighestHigh, LowestLow.
    b. The system verifies entry/exit conditions and sets appropriate orders for the opening of the next session and stop loss orders; it monitors the volatility regime.
5. **Additional Notes:**
    a. **No Short Positions:** The strategy focuses solely on long positions in an uptrend.
    b. **Financial Instruments:** For the purposes of this test, **long positions** on **stock indices, bonds, gold** and **the dollar index were used.**

The above rules are described in a way that allows them to be directly converted into a script in the chosen testing platform, which ensures the accuracy of the historical simulation and the reliability of the test results.

Tests are performed assuming that the risk of one position is **2.5% of the total capital,** with **a stop loss order** set at YY day low.

Step 3: Pre-test your investment strategy

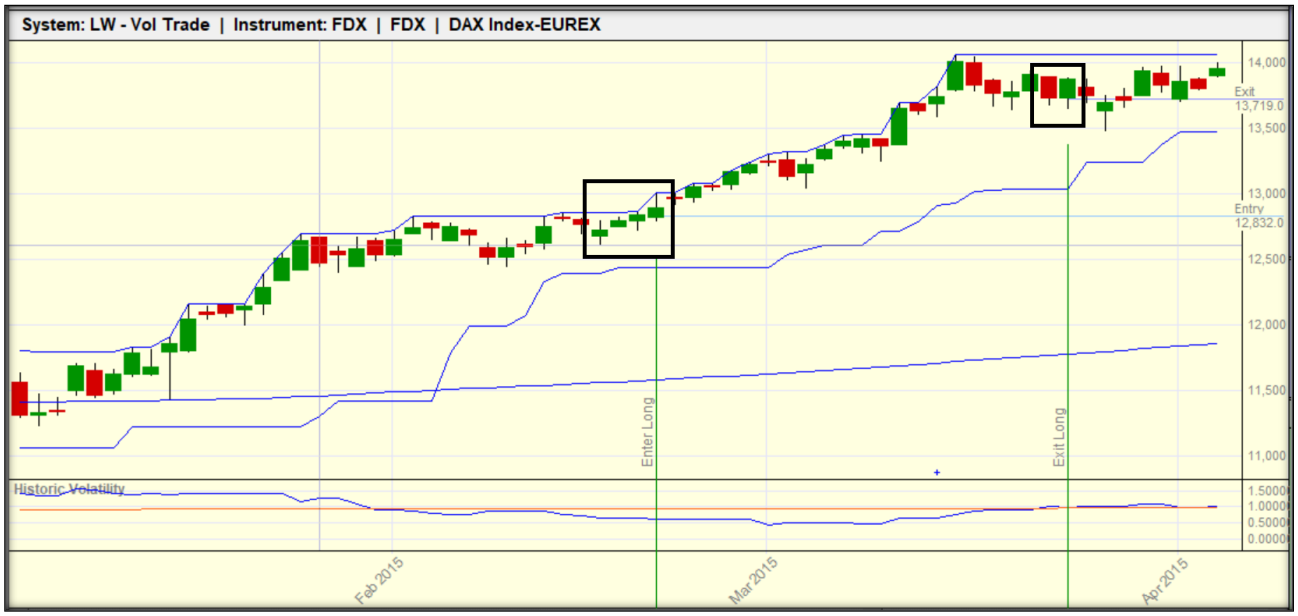
Below are some purchase and sale transactions that allow you to verify the following aspects:

- **Correctness of generated signals;**
- **Direction of opening a position;**
- **Moment of opening the position;**
- **The opening price of the position;**
- **Moment of closing the position;**
- **Closing price of the position;**
- **Compliance of the transaction with the theoretical assumptions of the investment strategy.**

At this stage, **it doesn't matter** whether the trades are **profitable,** what **instrument was used,** or whether they occurred **recently** or **in the distant past.** The key is **to verify that the trades are generated correctly** and in line with the assumptions described in the previous step.

The first transaction was made on a DAX futures contract. At the end of February 2015, the price remained in **an uptrend** (price above the long-term average), and **short-term volatility fell below long-term volatility ("Historic Volatility" panel). At that time, a volatility contraction** was formed – **short-term volatility fell below 80% of long-term volatility** (the first candle in the left-hand rectangle). A buy signal requires that such a drop in volatility be followed by **a candle that will establish a new local maximum.** This condition was met after a few days (the third candle in the rectangle on the left), which **generated a signal to open a long position.** According to the strategy rules, **the position was open at the opening of the next session** (fourth candle in the rectangle on the left). **The stop loss for the position was set at the level of a few days low** (blue line), which then moves with the market (trailing stop). **The system worked correctly.**

The strategy calls for **an exit when short-term volatility exceeds long-term volatility or when a stop loss order** (initial or trailing) is triggered. Short-term volatility exceeded long-term volatility at the end of March 2015 (the first candle in the right-hand rectangle), so the position was closed at the opening of the next session (the second candle in the right-hand rectangle). **The system worked correctly.**



Once we are sure that the transactions are generated correctly, we can proceed to the first test of the strategy on the full **in-sample data set**. These tests are conducted on **baseline parameters** that, in my opinion, should align with the strategy's stated goals.

First, **we reject strategies that linearly lose capital.** If a strategy exhibits this pattern, it's a clear signal that any parameter optimization is pointless.

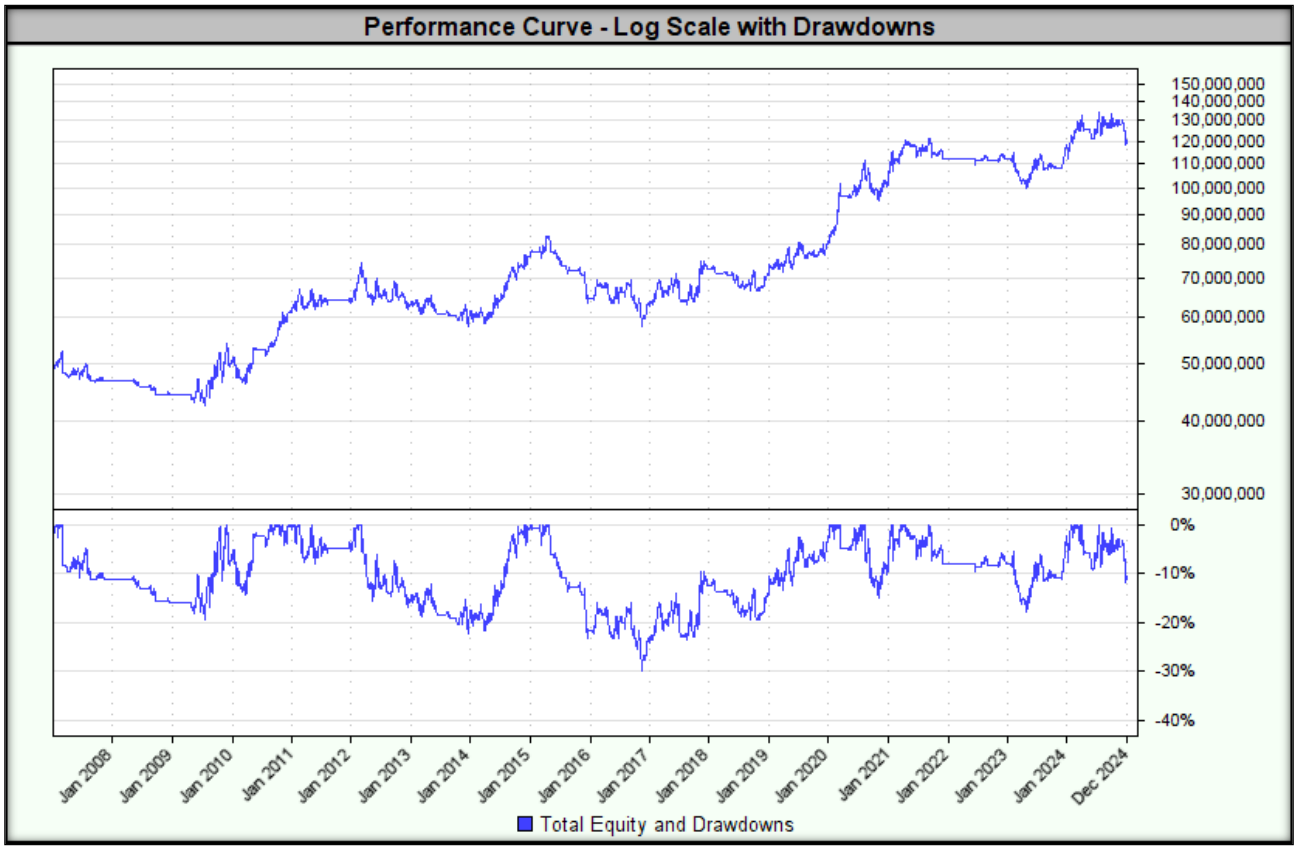
Our basic expectation is that the strategy generates **positive results,** even if they are at a low level.

Tested base parameters:

- **MALong –** 200-day moving average closing price.
- **VolLong** – 200-day volatility (sum of squared deviations).
- **VolShort** – 20-day volatility (sum of squared deviations).
- **VolRatio** – the variability ratio: VolShort/VolLong is at most 80%.
- **HighestHigh** – 20 day highest high.
- **LowestLow** – 20 day lowest low.
- **How to open a position** – once the conditions are met, a long position is opened at the opening of the next session.
- **Stop loss** – at the LowestLow level.
- **Closing a position** – all positions are closed when a defensive stop loss order is activated or at the opening of the next session when VolShort > VolLong.
- **Position size** – corresponding to a risk of 2.5% of the total capital, by stop loss order set to LowestLow.
- **Direction of position** – only long positions (buy).

The test result is shown below.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Indicators/Measures	Concluding a transaction at the opening price
CAGR%	4.9%
MAR Ratio	0.17
RAR%	5.8%
R-Cubed	0.10
Robust Sharpe Ratio	0.48
Max Drawdown	29.9%
Wins	42.0%
Losses	58.0%
Average Win%	2.19%
Average Loss%	1.15%
Win/Loss Ratio	1.90
Average Trade Duration (days)	37
Percent Profit Factor	1.38
SQN	0.53
Number of transactions	405

In summary, the system is working properly and generating signals as expected. Furthermore, tests on the baseline parameters yielded satisfactory results. We can now move on to the most interesting stage of creating an investment strategy – **optimization.**

Step 4: Optimizing and assessing the stability of the investment strategy

This stage of strategy development and testing is **crucial** because it determines how **effective** the strategy will be in **real-world conditions. I cannot** emphasize enough that for **a strategy to work** in real-world conditions, it must also perform under **suboptimal parameters** and **conditions.** In short, **it must be stable** to changing market conditions.

I don't know who said these words, but they perfectly capture the problem of many optimizations:

"I've never seen a strategy that didn't work in backtests."

My goal is not to find **optimal parameter values** – **my goal** is to find **a wide range of parameters** for which the strategy will generate **acceptable results. We don't know the future,** we don't know future market conditions, but if we know that our strategy **has historically generated acceptable results** in various market conditions and across various parameter ranges, then we are **one step ahead of other** market participants.

What **parameters to choose** for the next period is the topic of consideration in **Step 5, "Walk-Forward Analysis",** but before we get to that, **we need to know** whether our strategy is even **stable.**

1. Stability across a wide range of optimized parameters

This version of **the Vol Trade v.3 strategy utilizes the Grid Search** method **to optimize parameters.** This method **fully optimizes all specified parameters by creating a wide range of possible combinations.** Our goal is to find **parameter ranges** that **will keep the strategy stable (robust),** allowing us to assess its suitability in real-world market conditions.

The key criterion for assessing stability is that all test results must demonstrate a positive MAR, and the maximum drawdown must not exceed 250% of the drawdown for the result with the highest MAR. If any test produces a negative MAR, or if the drawdown exceeds 250% of the drawdown for the result with the highest MAR, the strategy is rejected entirely.

In the first step, we test the stability of the parameters on **in-sample data.** To do this, we define **ranges of** parameter values so that **the ratio of the highest to lowest value of the range is at least 150%.**

In the tested strategy, the ranges defined in this way are:

- **VolShort & HighestHigh & LowestLow:** range **16-25 days (step: 1);**
- **MALong & VolLong:** range **200-300 days (step: 5);**
- **VolRatio:** range **70%-90% (step: 2.5 pp).**

The lowest MAR value of 0.06 was achieved for the following parameters:

- **VolShort & HighestHigh & LowestLow:** 20 days;
- **MALong & VolLong:** 220 days;
- **VolRatio:** 70%.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Test	Volatility Short (Bars)	Volatility Long (bars)	Volatility Threshold (Vol Short/Vol Long)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
793	20	220	70.0%	$64,455,146.61	1.42%	0.05	0.18	0.15	26.7%	113.3	288
802	20	225	70.0%	$64,334,367.67	1.41%	0.06	0.18	0.16	25.5%	108.6	288
757	20	200	70.0%	$64,361,500.88	1.41%	0.06	0.18	0.15	25.5%	101.0	285
1	16	200	70.0%	$71,124,030.92	1.98%	0.06	0.22	0.19	33.2%	93.0	388
811	20	230	70.0%	$65,358,610.08	1.50%	0.06	0.19	0.15	24.0%	98.1	293
766	20	205	70.0%	$67,597,900.59	1.69%	0.06	0.21	0.18	26.7%	100.7	286
946	21	200	70.0%	$65,858,576.62	1.54%	0.07	0.20	0.18	23.7%	94.3	269
964	21	210	70.0%	$68,121,001.52	1.73%	0.07	0.22	0.23	26.3%	94.5	266
973	21	215	70.0%	$69,240,642.70	1.83%	0.07	0.23	0.23	26.5%	94.4	268
955	21	205	70.0%	$67,581,234.87	1.69%	0.07	0.22	0.22	23.6%	89.4	267
48	16	225	75.0%	$81,162,220.03	2.73%	0.08	0.27	0.20	34.4%	58.2	455
1135	22	200	70.0%	$65,119,409.52	1.48%	0.08	0.20	0.18	18.4%	58.4	257
1144	22	205	70.0%	$65,393,489.29	1.50%	0.08	0.20	0.19	18.5%	58.0	259
10	16	205	70.0%	$77,781,637.39	2.49%	0.08	0.26	0.24	30.2%	92.8	389

Below is a graph of the equity curve for **the strategy with the lowest MAR.**

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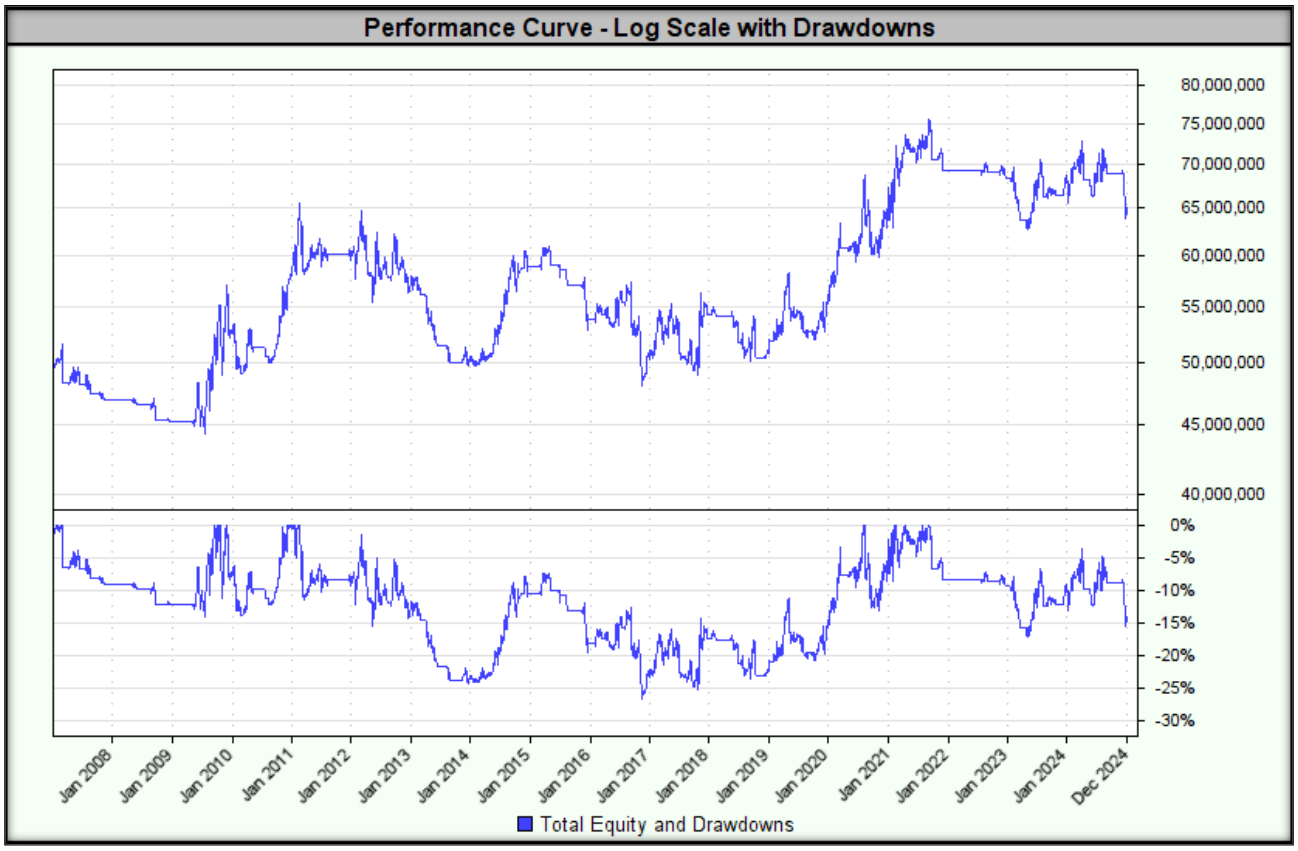

The highest MAR value of 0.51 was achieved for the following parameters:

- **VolShort & HighestHigh & LowestLow:** 23 days;
- **MALong & VolLong:** 300 days;
- **VolRatio:** 82.5%.

The highest MAR value was accompanied by **a drawdown of 15.7%.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Test	Volatility Short (Bars)	Volatility Long (bars)	Volatility Threshold (Vol Short/Vol Long)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
1509	23	300	82.5%	$201,837,023.83	8.06%	0.51	0.74	0.71	15.7%	37.3	355
1463	23	275	80.0%	$184,652,428.88	7.53%	0.50	0.72	0.74	14.9%	40.5	338
1472	23	280	80.0%	$190,407,019.07	7.71%	0.50	0.72	0.72	15.6%	40.5	338
1491	23	290	82.5%	$185,922,613.01	7.57%	0.49	0.69	0.66	15.3%	38.8	357
1482	23	285	82.5%	$199,907,086.35	8.00%	0.49	0.73	0.70	16.3%	37.8	354
1701	24	300	90.0%	$254,912,730.36	9.47%	0.49	0.80	0.73	19.4%	36.1	383
1500	23	295	82.5%	$195,531,190.27	7.87%	0.48	0.72	0.71	16.4%	37.4	356
1683	24	290	90.0%	$238,368,754.19	9.06%	0.48	0.78	0.75	18.9%	36.4	380
1699	24	300	85.0%	$213,806,109.96	8.41%	0.47	0.75	0.70	17.8%	36.4	356
1481	23	285	80.0%	$188,404,740.27	7.65%	0.47	0.71	0.71	16.2%	40.5	338
1700	24	300	87.5%	$228,549,010.50	8.81%	0.47	0.76	0.69	18.7%	36.4	370
1503	23	295	90.0%	$234,874,793.33	8.98%	0.46	0.76	0.72	19.6%	37.3	401
1494	23	290	90.0%	$229,186,104.68	8.83%	0.45	0.75	0.70	19.5%	37.2	395
1512	23	300	90.0%	$240,973,693.36	9.13%	0.45	0.77	0.70	20.3%	37.3	401

Below is a graph of the equity curve for **the strategy with the highest MAR.**

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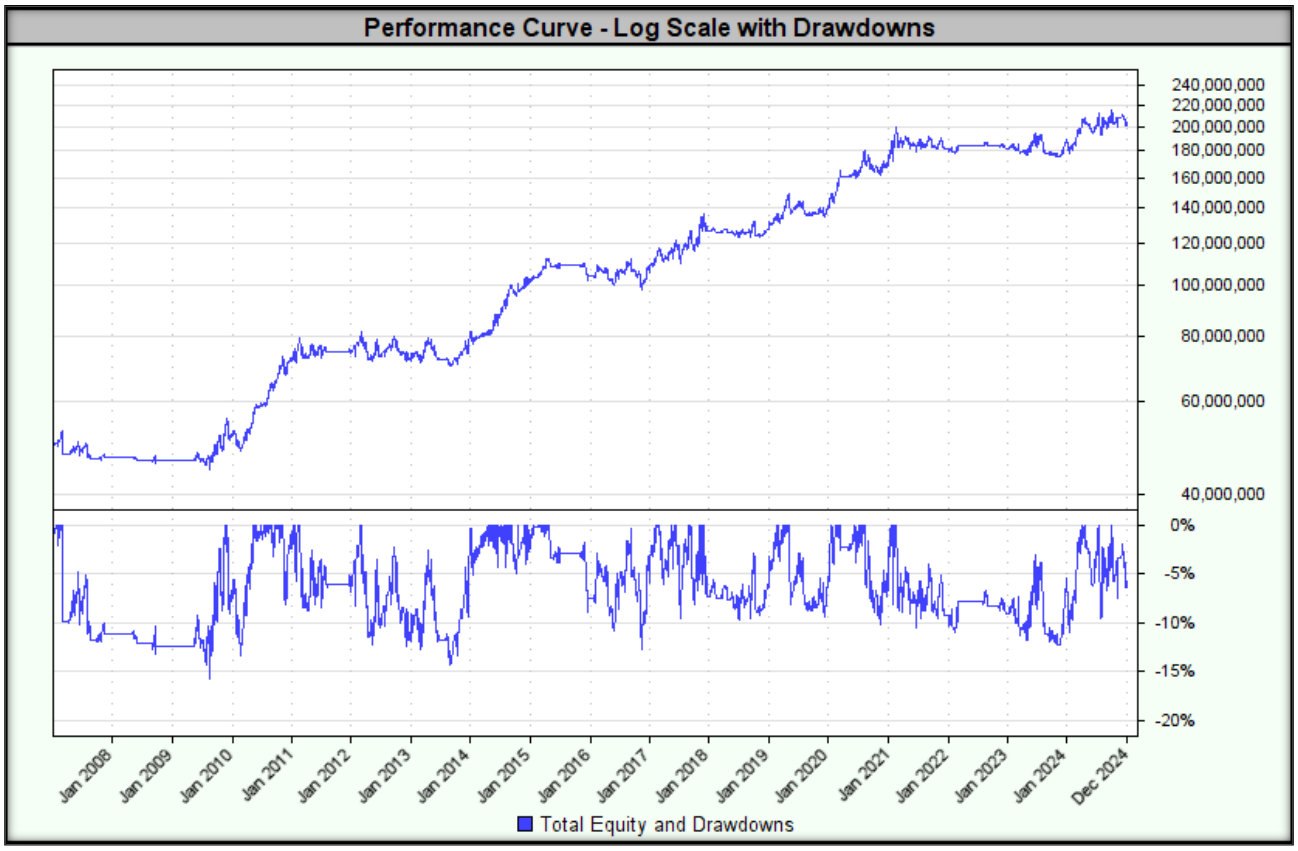


For all combinations of tested parameter ranges, **the highest drawdown was 40.7%.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

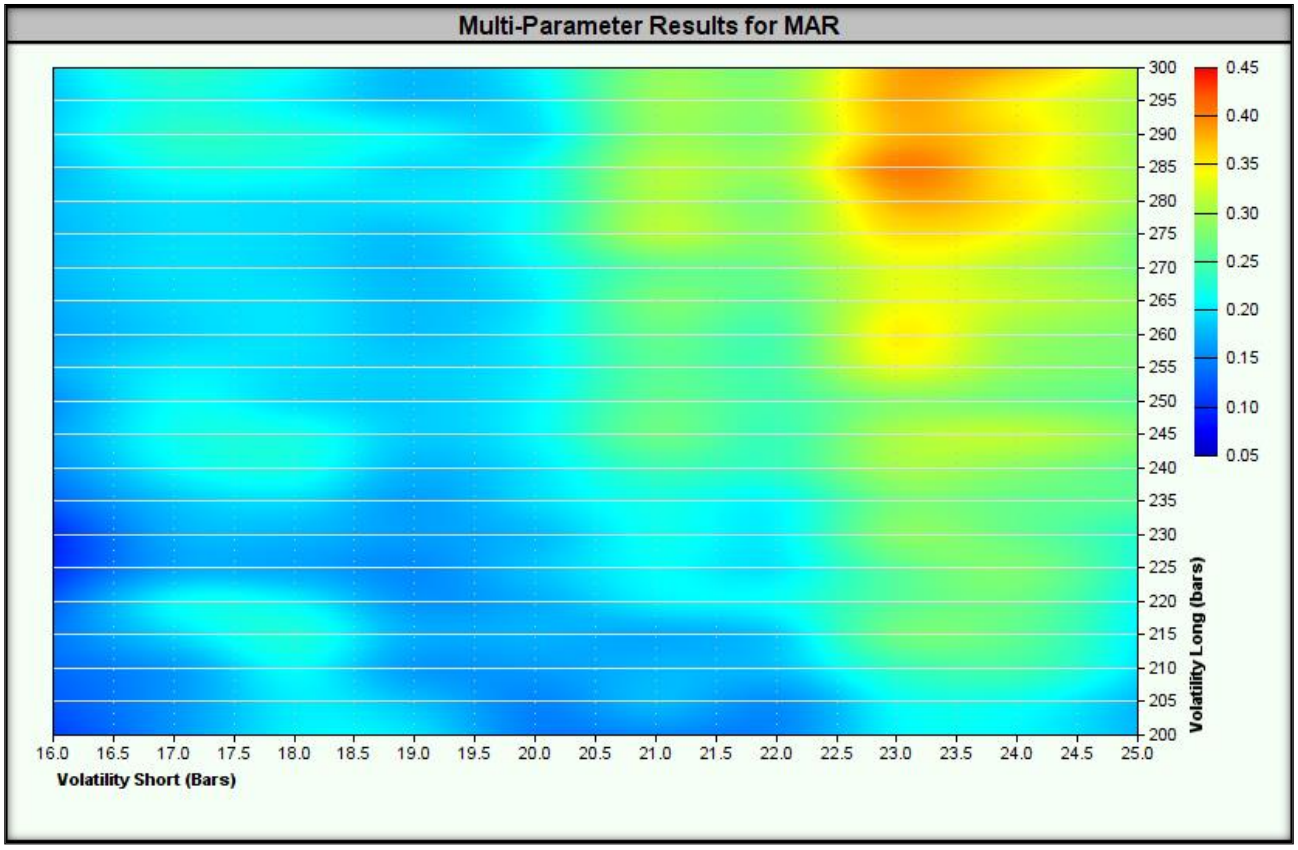
Test	Volatility Short (Bars)	Volatility Long (bars)	Volatility Threshold (Vol Short/Vol Long)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
53	16	225	87.5%	$105,820,604.50	4.25%	0.10	0.36	0.27	40.7%	48.2	588
63	16	230	90.0%	$107,114,226.24	4.32%	0.11	0.37	0.28	40.1%	47.9	615
54	16	225	90.0%	$107,883,606.03	4.37%	0.11	0.37	0.27	40.1%	47.9	612
62	16	230	87.5%	$106,986,460.18	4.32%	0.11	0.37	0.29	39.9%	50.5	593
52	16	225	85.0%	$111,826,374.10	4.57%	0.12	0.39	0.29	39.7%	46.2	558
242	17	225	87.5%	$150,136,483.75	6.30%	0.16	0.51	0.41	39.6%	54.4	553
7	16	200	85.0%	$120,325,796.37	5.00%	0.13	0.42	0.35	39.5%	45.9	561
241	17	225	85.0%	$147,358,509.29	6.19%	0.16	0.51	0.41	39.3%	56.2	525
216	17	210	90.0%	$152,735,349.99	6.40%	0.16	0.51	0.40	39.3%	47.9	583
224	17	215	87.5%	$158,618,965.61	6.62%	0.17	0.53	0.44	39.3%	50.3	559
44	16	220	87.5%	$114,521,419.14	4.71%	0.12	0.39	0.31	39.2%	48.0	590
8	16	200	87.5%	$119,191,826.23	4.94%	0.13	0.41	0.33	39.2%	47.9	591
243	17	225	90.0%	$140,006,063.67	5.89%	0.15	0.48	0.37	39.1%	47.9	584
214	17	210	85.0%	$139,798,444.45	5.88%	0.15	0.49	0.39	39.1%	53.1	531

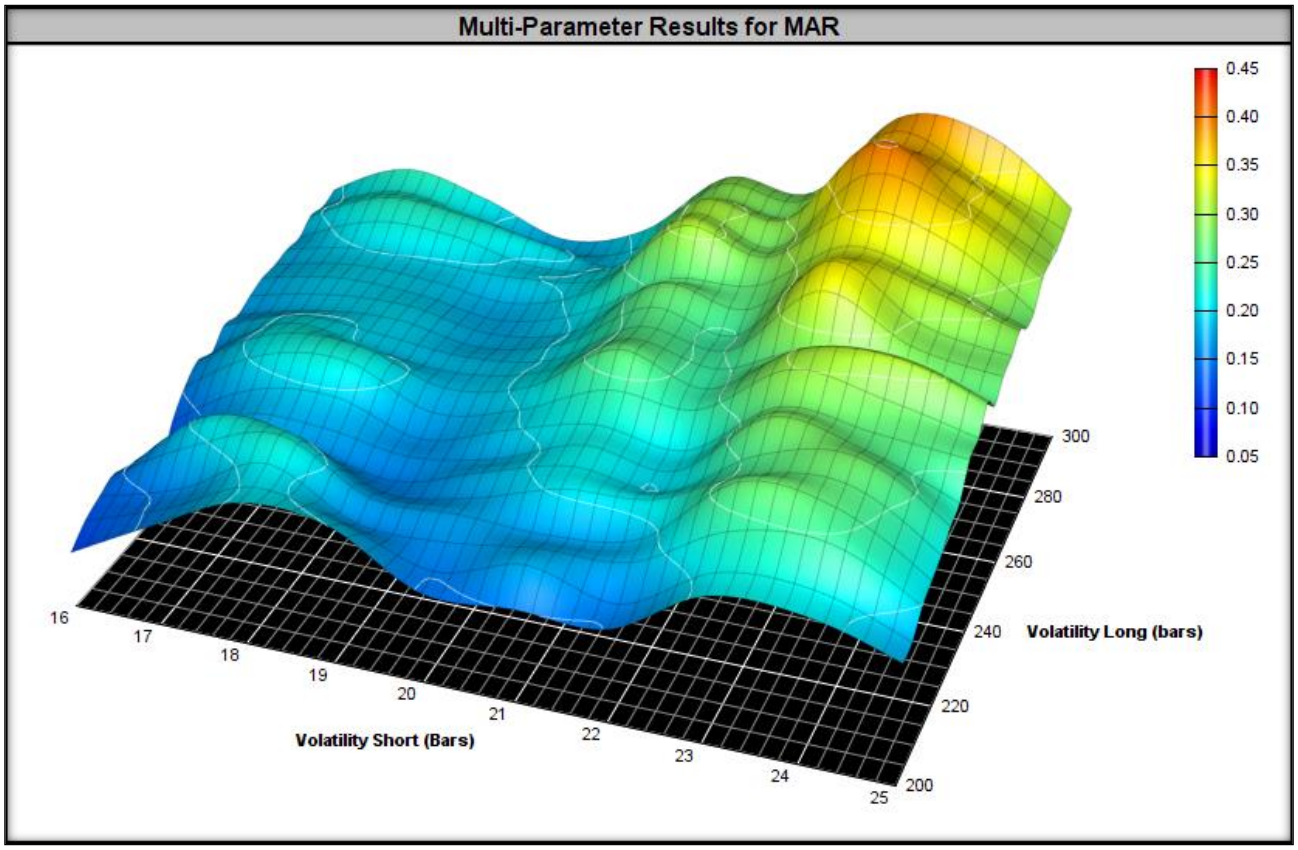
In summary, the strategy **failed the stability test** over a wide range of optimized parameters because:

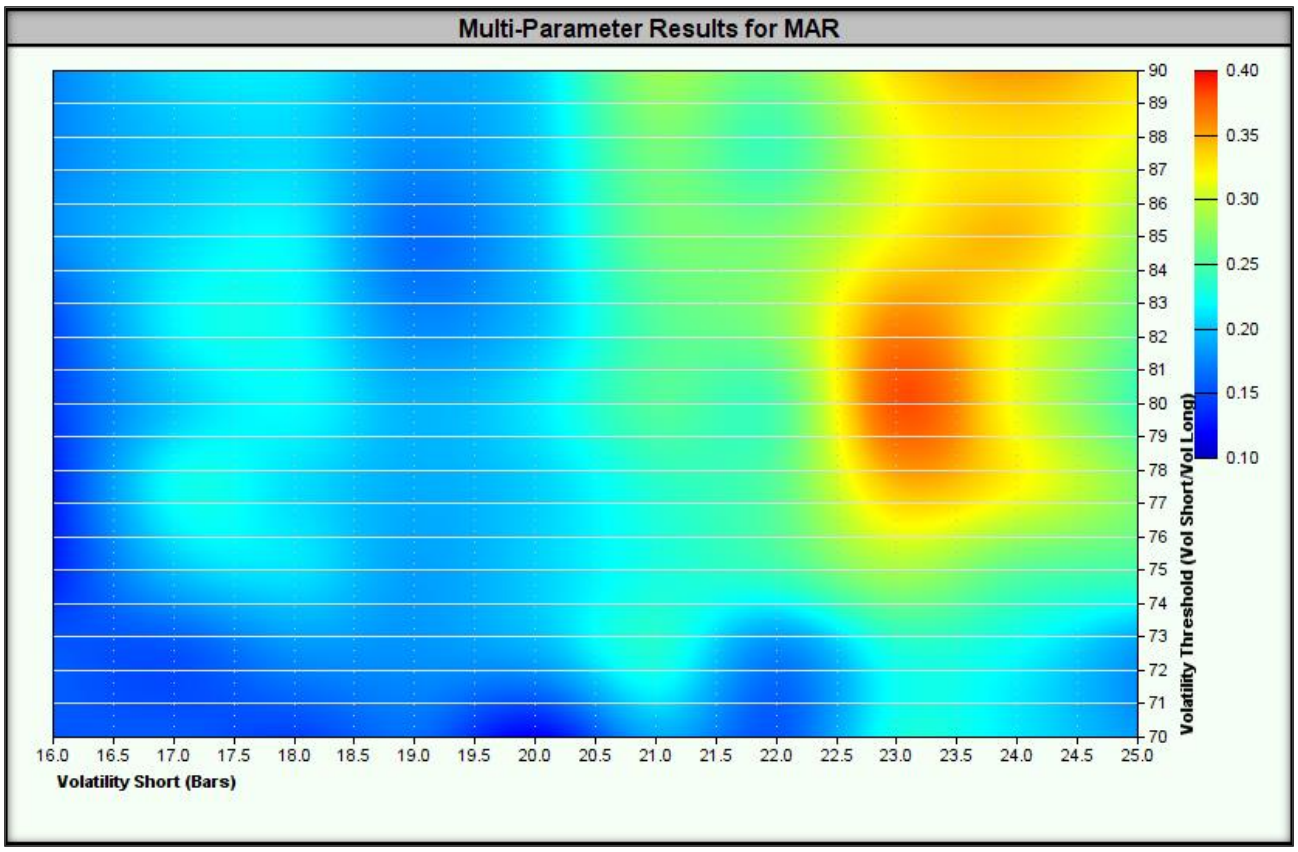
- **The maximum drawdown exceeded 250% of the drawdown value** for the result with the highest MAR (**40.7% vs. 15.7%)** – which means a high risk of deep capital drawdowns.

Therefore, **<u>further testing of the strategy is not justified,</u>** as its use in real transactions **is highly doubtful.**

Heatmaps for the tested ranges are shown below.




Multi-Parameter Results for MAR
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
300
280
260
240
220
200
Volatility Long (bars)
16
17
18
19
20
21
22
23
24
25
Volatility Short (Bars)


Multi-Parameter Results for MAR
0.40
0.35
0.30
0.25
0.20
0.15
0.10
90
89
88
87
86
85
84
83
82
81
80
79
78
77
76
75
74
73
72
71
70
Volatility Threshold (Vol Short/Vol Long)
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
20.5
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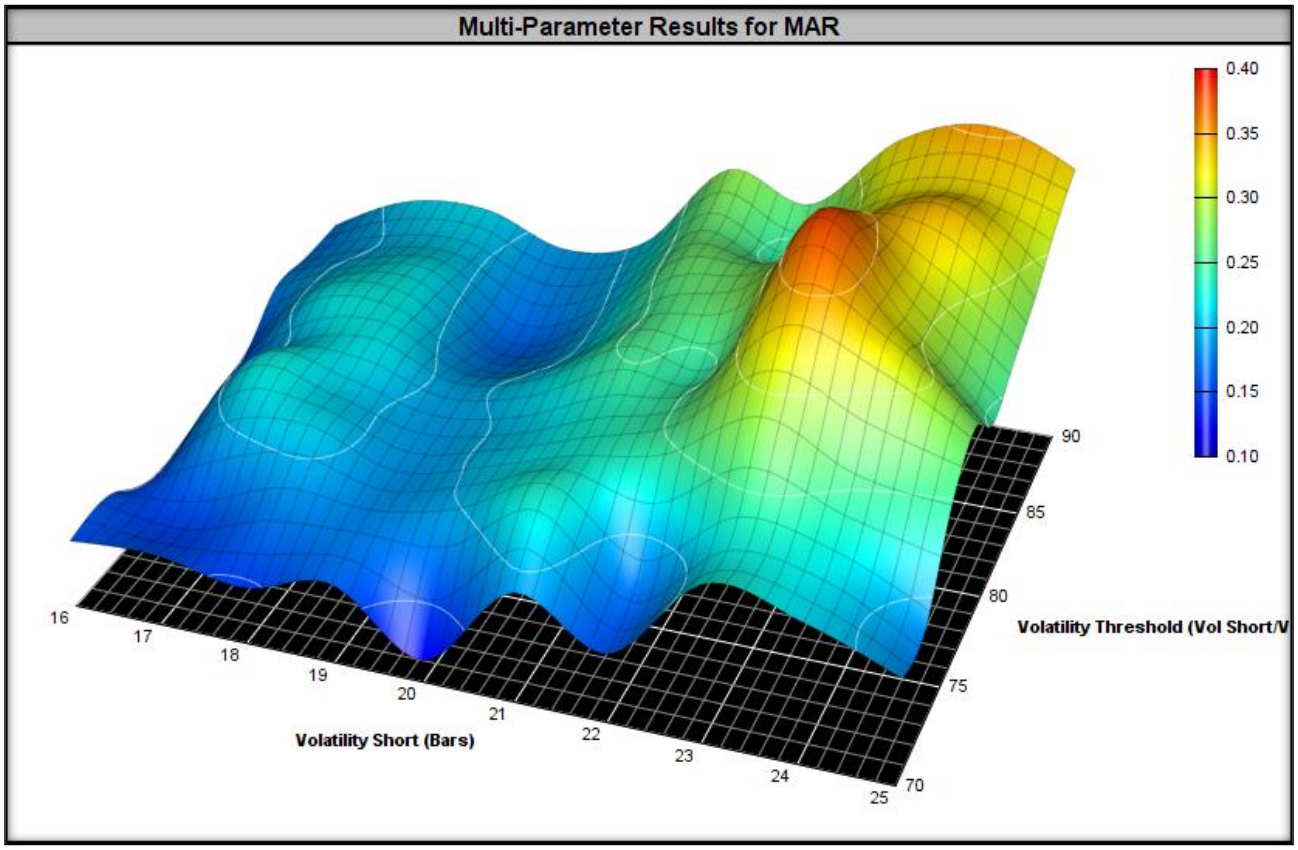
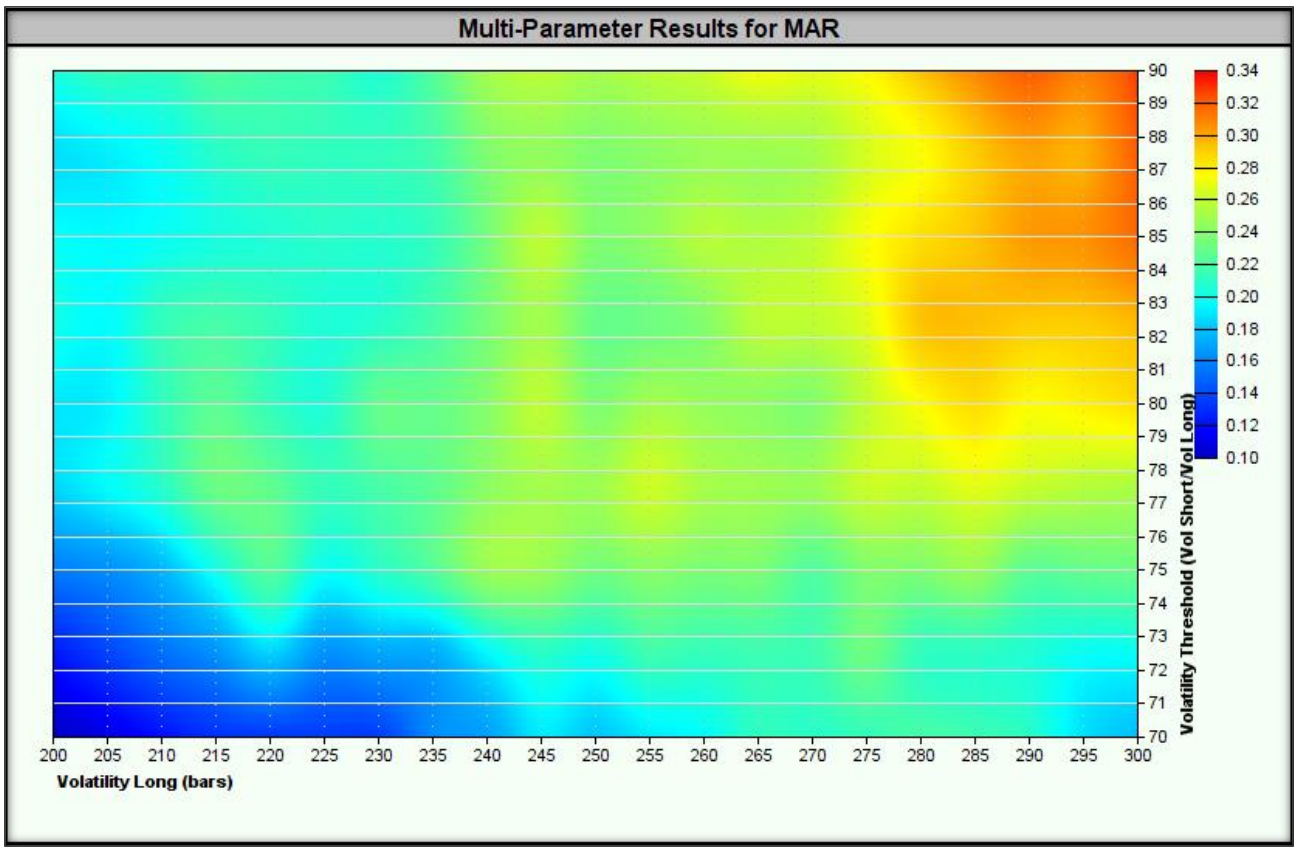
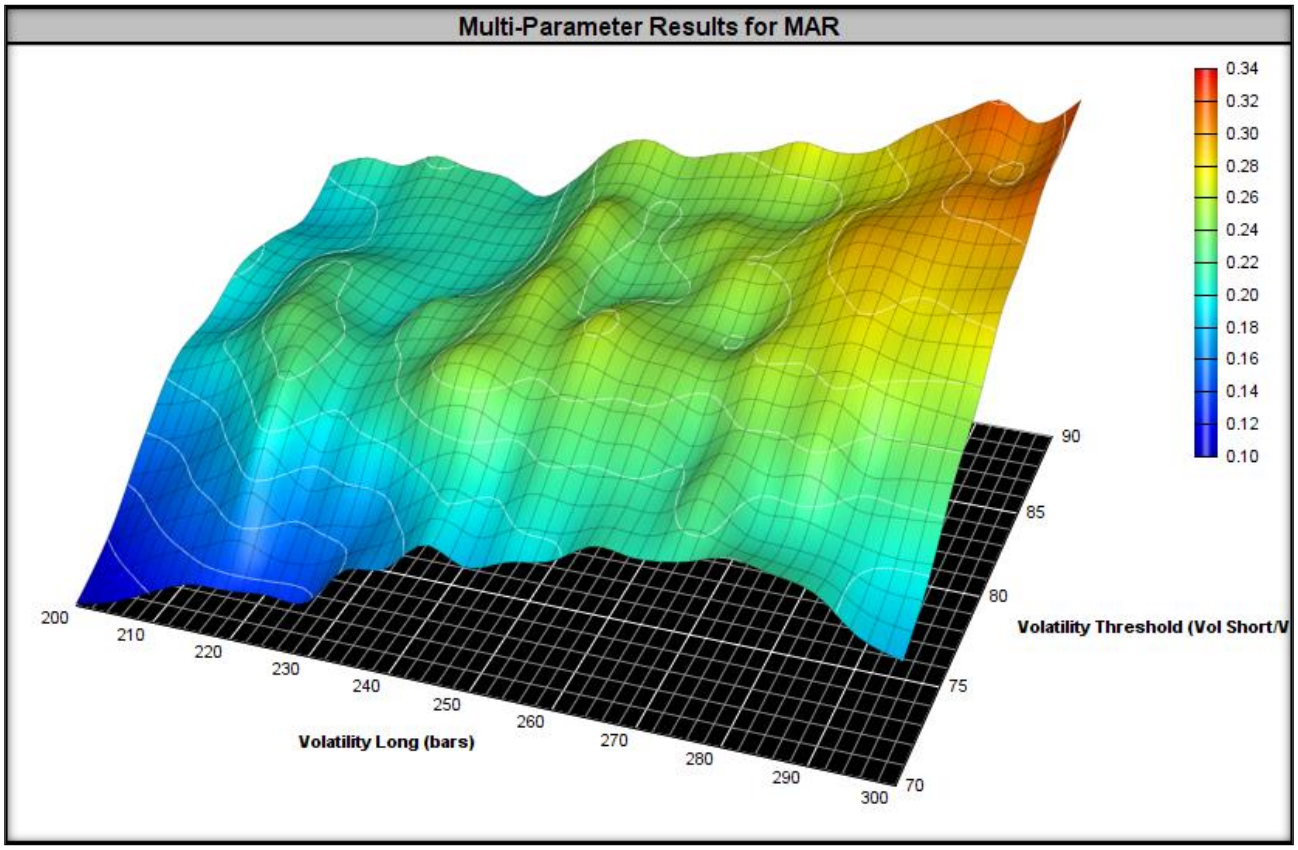
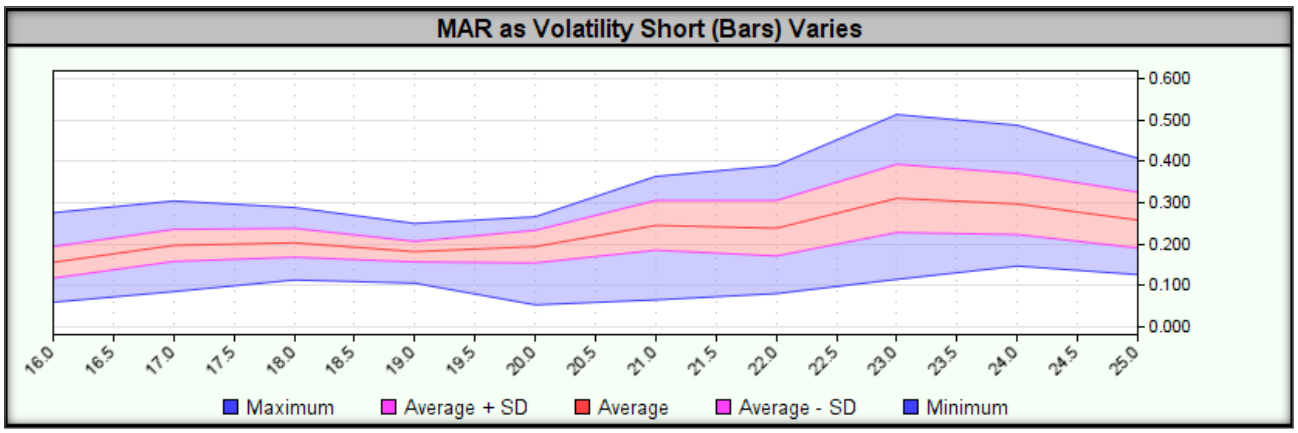
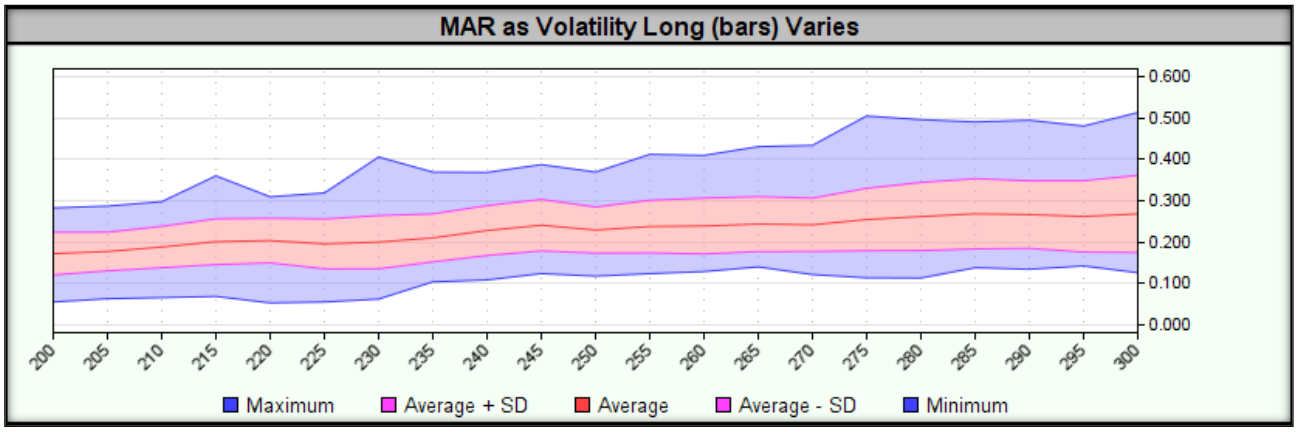
23.5
24.0
24.5
25.0
Volatility Short (Bars)

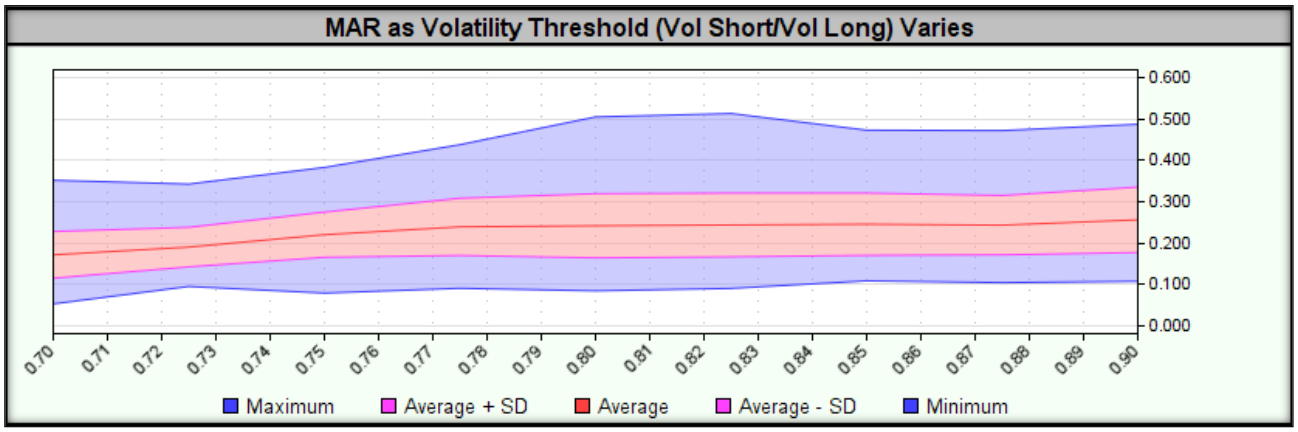

Multi-Parameter Results for MAR
0.40
0.35
0.30
0.25
0.20
0.15
0.10
16
17
18
19
20
21
22
23
24
25
Volatility Short (Bars)
70
75
80
85
90
Volatility Threshold (Vol Short/V


Multi-Parameter Results for MAR
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300
Volatility Long (bars)
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
Volatility Threshold (Vol Short/Vol Long)


Multi-Parameter Results for MAR
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
200
210
220
230
240
250
260
270
280
290
300
Volatility Long (bars)
90
85
80
75
70
Volatility Threshold (Vol Short/V


MAR as Volatility Short (Bars) Varies
0.600
0.500
0.400
0.300
0.200
0.100
0.000
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
20.5
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
Maximum
Average + SD
Average
Average - SD
Minimum





2. **Monte Carlo simulation**

The step was omitted due to **failure of previous stability tests.**

3. **Stability over a moving time window**

The step was omitted due to **failure of previous stability tests.**

4. **Long/short stability**

The step was omitted due to **failure of previous stability tests.**

5. **Stability in the portfolio of financial instruments**

The step was omitted due to **failure of previous stability tests.**

6. **Money Management (Position Sizing)**

The step was omitted due to **failure of previous stability tests.**

7. **Strategy Risk Management**

The step was omitted due to **failure of previous stability tests.**

Step 5: Walk-Forward Analysis

This step was omitted due to **failure of previous stability tests.**

Step 6: Using the strategy in real time

This step was omitted due to **failure of previous stability tests.**