

QGS Quantitative Research

Executive Summary Report

Optimal ATR-Based Exit Strategies

Phase 1 & 2 Results: LONG and SHORT Signals

Phase	Signal Type	Signals Tested	Strategies	Combinations	Best Strategy	Best Return
Phase 1	LONG	~80,129	4	188	Fixed ATR Asymmetric	+\$837,370
Phase 2	SHORT	~60,033	4	172	ATR Trailing Stop	+\$859,092
TOTAL	BOTH	~140,162	8	360	—	+\$1,696,462

Key Findings

- **Combined Profitability:** Best LONG and SHORT strategies together earn **+\$1.7M** across 140K signals (2007-2024).
- **SHORT Outperforms LONG:** ATR Trailing Stop SHORT (+\$859K) beats Fixed ATR Asymmetric LONG (+\$837K) by \$22K.
- **Different Strategies Win:** LONG favors asymmetric exits, SHORT favors trailing stops.
- **Tight Stops Critical:** Both winners use 1.5x ATR multiplier for stop loss.
- **Ready for Implementation:** Optimal parameters identified for live trading or further backtesting.

Phase 1: LONG Signals - Winner

Strategy: Fixed ATR Asymmetric

Parameter	Value	Description
Strategy Name	Fixed ATR Asymmetric	Asymmetric stop/target multipliers
ATR Period	50	Longer period for stability
Stop Multiplier	1.5×	Tight stop to limit losses
Target Multiplier	6.0×	Wide target to capture large moves
Net Profit	+\$837,370	Across 80,129 LONG signals
Profit Factor	1.112	Strong positive edge
Win Rate	29.0%	Low but offset by large wins
Total Trades	80,076	Comprehensive test
Avg Win	\$428.63	Large average winning trade
Avg Loss	\$151.20	Small average losing trade
Win/Loss Ratio	2.83:1	Wins are 2.83× larger than losses

Strategy Logic - LONG Signals

The Fixed ATR Asymmetric strategy uses different multipliers for stop loss and profit target, allowing for **tight stops** to quickly cut losses while maintaining **wide targets** to capture large winning moves. This asymmetry creates a favorable risk/reward profile where losses are small and frequent, but wins are large and compensate for the low win rate.

1. **Entry:** Buy at signal bar CLOSE price
2. **Stop Loss:** Entry - (ATR(50) × 1.5) = Entry - 1.5× ATR below entry
3. **Profit Target:** Entry + (ATR(50) × 6.0) = Entry + 6.0× ATR above entry
4. **Exit Check:** On each bar, exit if LOW ≤ Stop OR HIGH ≥ Target
5. **Time Limit:** Close position at market if not exited within 30 bars
6. **Position Size:** \$100,000 / Entry Price = Number of shares

Implementation Code - LONG Strategy

```
# Fixed ATR Asymmetric - LONG Signal Implementation
import pandas as pd
import numpy as np

def calculate_atr(df, period=50):
    """Calculate Average True Range."""
    high_low = df['High'] - df['Low']
    high_close = np.abs(df['High'] - df['Close'].shift())
    low_close = np.abs(df['Low'] - df['Close'].shift())
    tr = pd.concat([high_low, high_close, low_close], axis=1).max(axis=1)
    atr = tr.rolling(window=period).mean()
    return atr

def backtest_long_asymmetric(df, symbol):
    """
    Backtest Fixed ATR Asymmetric on LONG signals.
    Best Parameters: ATR(50), Stop 1.5x, Target 6.0x
    """
    ATR_PERIOD = 50
    STOP_MULT = 1.5
    TARGET_MULT = 6.0
    MAX_BARS = 30
    POSITION_SIZE = 100000.0

    trades = []
    signal_indices = df[df['Signal'] == 1].index.tolist() # LONG signals

    df['ATR'] = calculate_atr(df, period=ATR_PERIOD)

    for signal_idx in signal_indices:
        entry_bar_idx = df.index.get_loc(signal_idx)
        entry_price = df.loc[signal_idx, 'Close']
        entry_atr = df.loc[signal_idx, 'ATR']

        if pd.isna(entry_atr) or entry_atr == 0:
            continue

        shares = POSITION_SIZE / entry_price

        # LONG: Stop BELOW entry, Target ABOVE entry
        stop_loss = entry_price - (STOP_MULT * entry_atr)
        profit_target = entry_price + (TARGET_MULT * entry_atr)

        # Check exits
        for i in range(entry_bar_idx + 1, min(entry_bar_idx + MAX_BARS + 1, len(df))):
            current_idx = df.index[i]
            bars_in_trade = i - entry_bar_idx

            # Check stop (LOW touches stop)
            if df.loc[current_idx, 'Low'] <= stop_loss:
                exit_price = stop_loss
                exit_reason = 'STOP'
                break

            # Check target (HIGH touches target)
            if df.loc[current_idx, 'High'] >= profit_target:
                exit_price = profit_target
```

```

        exit_reason = 'TARGET'
        break

    # Time limit
    if bars_in_trade >= MAX_BARS:
        exit_price = df.loc[current_idx, 'Close']
        exit_reason = 'TIME'
        break
    else:
        # No exit found within time limit
        exit_price = df.iloc[min(entry_bar_idx + MAX_BARS, len(df)-1)]['Close']
        exit_reason = 'TIME'

    # Calculate P&L
    net_profit = (exit_price - entry_price) * shares

    trades.append({
        'Symbol': symbol,
        'EntryPrice': entry_price,
        'ExitPrice': exit_price,
        'StopLoss': stop_loss,
        'Target': profit_target,
        'ExitReason': exit_reason,
        'NetProfit': net_profit,
        'Shares': shares
    })

return pd.DataFrame(trades)

# Usage Example:
# df = pd.read_parquet('your_data.parquet')
# df = df[df['Symbol'] == 'AAPL'].sort_values('Date')
# results = backtest_long_asymmetric(df, 'AAPL')
# print(f"Total Profit: ${results['NetProfit'].sum():,.2f}")

```

Phase 2: SHORT Signals - Winner

Strategy: ATR Trailing Stop

Parameter	Value	Description
Strategy Name	ATR Trailing Stop	Dynamic trailing stop mechanism
ATR Period	30	Optimal responsiveness
Multiplier	1.5×	Tight trailing stop
Target	None	Let winners run (no fixed target)
Net Profit	+\$859,092	Across 60,033 SHORT signals
Profit Factor	1.139	Highest among SHORT strategies
Win Rate	34.3%	Low but acceptable with trailing
Total Trades	60,033	All SHORT signals tested
Avg Win	\$342.19	Trailing captures large moves
Avg Loss	\$157.30	Tight stop limits losses
Win/Loss Ratio	2.18:1	Wins are 2.18× larger than losses
Avg Bars in Trade	8.7	Quick exits preserve capital

Strategy Logic - SHORT Signals

The ATR Trailing Stop strategy uses a **dynamic stop** that moves DOWN as price falls, locking in profits while allowing winners to run. For SHORT positions, the stop starts ABOVE the entry price and trails downward, tightening as the trade becomes more profitable. This mechanism is particularly effective for SHORT signals as it protects against sudden upward reversals while capturing extended downward moves.

1. **Entry:** Sell SHORT at signal bar CLOSE price
2. **Initial Stop:** $\text{Entry} + (\text{ATR}(30) \times 1.5) = \text{Entry} + 1.5 \times \text{ATR}$ above entry
3. **Trailing Logic:** $\text{Stop} = \text{MIN}(\text{previous_stop}, \text{Current HIGH} + \text{ATR}(30) \times 1.5)$
4. **Stop Movement:** Stop only moves DOWN (tighter), never UP (looser)
5. **Exit Check:** On each bar, exit if $\text{HIGH} \geq \text{Stop}$ (stopped out)
6. **Time Limit:** Close position at market if not exited within 20 bars
7. **Position Size:** $\$100,000 / \text{Entry Price} = \text{Number of shares}$

8. **P&L; Calculation:** (Entry Price - Exit Price) × Shares

Implementation Code - SHORT Strategy

```
# ATR Trailing Stop - SHORT Signal Implementation
import pandas as pd
import numpy as np

def calculate_atr(df, period=30):
    """Calculate Average True Range."""
    high_low = df['High'] - df['Low']
    high_close = np.abs(df['High'] - df['Close'].shift())
    low_close = np.abs(df['Low'] - df['Close'].shift())
    tr = pd.concat([high_low, high_close, low_close], axis=1).max(axis=1)
    atr = tr.rolling(window=period).mean()
    return atr

def backtest_short_trailing(df, symbol):
    """
    Backtest ATR Trailing Stop on SHORT signals.
    Best Parameters: ATR(30), Multiplier 1.5x
    """
    ATR_PERIOD = 30
    MULTIPLIER = 1.5
    MAX_BARS = 20
    POSITION_SIZE = 100000.0

    trades = []
    signal_indices = df[df['Signal'] == -1].index.tolist() # SHORT signals

    df['ATR'] = calculate_atr(df, period=ATR_PERIOD)

    for signal_idx in signal_indices:
        entry_bar_idx = df.index.get_loc(signal_idx)
        entry_price = df.loc[signal_idx, 'Close']
        entry_atr = df.loc[signal_idx, 'ATR']

        if pd.isna(entry_atr) or entry_atr == 0:
            continue

        shares = POSITION_SIZE / entry_price

        # SHORT: Initial stop ABOVE entry (loss if price rises)
        initial_stop = entry_price + (MULTIPLIER * entry_atr)
        current_stop = initial_stop

        # Check exits
        for i in range(entry_bar_idx + 1, min(entry_bar_idx + MAX_BARS + 1, len(df))):
            current_idx = df.index[i]
            current_atr = df.loc[current_idx, 'ATR']
            bars_in_trade = i - entry_bar_idx

            # Update trailing stop (moves DOWN only)
            if not pd.isna(current_atr) and current_atr > 0:
                new_stop = df.loc[current_idx, 'High'] + (MULTIPLIER * current_atr)
                current_stop = min(current_stop, new_stop) # Move DOWN (tighter)

            # Check if stopped out (price rises to hit stop)
            if df.loc[current_idx, 'High'] >= current_stop:
                exit_price = current_stop
                exit_reason = 'STOP'
```

```

        break

    # Time limit
    if bars_in_trade >= MAX_BARS:
        exit_price = df.loc[current_idx, 'Close']
        exit_reason = 'TIME'
        break
    else:
        # No exit found within time limit
        exit_price = df.iloc[min(entry_bar_idx + MAX_BARS, len(df)-1)]['Close']
        exit_reason = 'TIME'

    # Calculate P&L (SHORT: profit when exit < entry)
    net_profit = (entry_price - exit_price) * shares

    trades.append({
        'Symbol': symbol,
        'EntryPrice': entry_price,
        'ExitPrice': exit_price,
        'InitialStop': initial_stop,
        'FinalStop': current_stop,
        'ExitReason': exit_reason,
        'NetProfit': net_profit,
        'Shares': shares
    })

return pd.DataFrame(trades)

# Usage Example:
# df = pd.read_parquet('your_data.parquet')
# df = df[df['Symbol'] == 'AAPL'].sort_values('Date')
# results = backtest_short_trailing(df, 'AAPL')
# print(f"Total Profit: ${results['NetProfit'].sum():.2f}")

```


Strategy Comparison: LONG vs SHORT

Metric	LONG (Asymmetric)	SHORT (Trailing)	Difference
Net Profit	+\$837,370	+\$859,092	+\$21,722 (SHORT wins)
Profit Factor	1.112	1.139	+0.027 (SHORT better)
Win Rate	29.0%	34.3%	+5.3% (SHORT better)
Avg Win	\$428.63	\$342.19	-\$86.44 (LONG better)
Avg Loss	\$151.20	\$157.30	-\$6.10 (LONG better)
Win/Loss Ratio	2.83:1	2.18:1	LONG has larger wins
Avg Bars in Trade	~15-20	8.7	SHORT exits faster
Stop Type	Fixed (1.5x ATR)	Trailing (1.5x ATR)	Different mechanisms
Target Type	Fixed (6.0x ATR)	None (let run)	LONG has fixed target

Key Insights from Comparison

- **SHORT Slightly Better:** Trailing stop SHORT earns \$22K more than asymmetric LONG.
- **Different Approaches:** LONG uses fixed wide targets, SHORT uses trailing stops without targets.
- **Both Use 1.5x Stops:** Tight stop loss is critical for both signal types.
- **LONG Has Larger Wins:** Fixed 6.0x target captures bigger moves, but lower win rate.
- **SHORT Exits Faster:** Trailing mechanism exits quickly, preserving capital.
- **Combined Strategy:** Using both together provides diversification and +\$1.7M total profit.

Next Steps: Detailed Backtesting Phase

With optimal parameters identified for both LONG and SHORT signals, the next phase involves comprehensive backtesting to validate performance, analyze equity curves, calculate risk metrics, and prepare for live implementation.

Phase	Task	Description	Output
Phase 3a	Generate Trade Logs	Re-run best configs to save all individual trades	Parquet files with full trade details
Phase 3b	Equity Curve Analysis	Plot cumulative returns over time	Equity curve charts vs benchmark
Phase 3c	Risk Metrics	Calculate Sharpe, Sortino, Max DD, Calmar	Comprehensive risk report
Phase 3d	Drawdown Analysis	Analyze underwater periods and recovery	Drawdown charts and statistics
Phase 3e	Monthly/Yearly Returns	Break down performance by period	Return distribution tables
Phase 3f	Trade Analysis	Analyze trade duration, MAE, MFE	Trade efficiency metrics
Phase 3g	Final Report	Combine all analyses into tear sheet	Complete performance tear sheet

Conclusion

The optimization phase has successfully identified the best ATR-based exit strategies for both LONG and SHORT signals. The Fixed ATR Asymmetric strategy (ATR 50, Stop 1.5x, Target 6.0x) is optimal for LONG signals with +\$837K profit, while the ATR Trailing Stop strategy (ATR 30, Multiplier 1.5x) is optimal for SHORT signals with +\$859K profit. Combined, these strategies generate **+\$1.7M** across 140K signals over 17 years (2007-2024). The next phase will validate these results through detailed backtesting and prepare for live implementation.